THE

ELECTRICAL REVIEW.

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THERMAL EFFICIENCIES IN THE BOILER HOUSE.

WE expressed last week our regret at Mr. Bennis's extreme sensitiveness in regard to our strictures on this subject, strictures which were general and certainly were not intended in any personal light. The question at issue is really that of the feasibility of securing a thermal efficiency of 85 per cent. from a combined plant consisting of a boiler, economiser and superheater. Even on special tests, when all the necessary allowances which should be reckoned to get a scientifically accurate test have been made, such as that of the heat value of the power used for driving automatic stokers and economiser scrapers, we still have our doubts as to the difficulty of securing such tests in a duly authenticated form, while as for continuous working, it seems almost an impossibility. In his letter last week Mr. Bennis wrote rather caustically concerning the concluding words of the first paragraph of our article. Had he treated the article as a whole, and paid attention to the remaining arguments, he would have appreciated the fact that our scepticism was as to the feasibility of securing from a complete equipment with the specified accessories the high efficiency claimed. Further, our remark on calorimeters was based on the fact that these are not always interchangeable instruments of precision, and that the results from calorimetric tests do not always correspond with the results calculable from chemical analyses. The Engineering Standards Committee might do worse than standardise fuel calorimeters. Pending that happy time, a series of readings of various instruments tested with different kinds of coal would serve to establish a mean discrepancy margin between these and the results deducible from an analysis.

While the science of thermodynamics has passed from the realms of inexactitude to exactitude, there is still much ground for the application of sound principles to the recording and checking of heat wastes. For instance, in central station work a compilation of returns from various stations (where the steam-raising plant was as nearly as possible identical), showing the ratio between the load factor and the thermal efficiency of the boiler *plus* its accessories, would not be without interest. Not many returns, we trow, would exceed 70 per cent. for continuous working, week in week out, when radiation losses during light load had been allowed for.

Two letters in our "Correspondence" columns of this week throw an interesting light on the question of boiler efficiencies. The first of these constrains the disclosure on our part—now that Mr. W. H. Booth has repudiated identity with "Calories" of the former correspondence—that the writer of the article to which Mr. Bennis took exception was not one and the same person as "Calories." For the rest Mr. Booth forwards with his letter a copy of his tests of the Davies boiler, in regard to which we have hardly sufficient room to reprint it *in extenso* as Mr. Booth asks. Mention can only be made of its one weak point. As the author points out, in the absence of analyses of the flue gases, the weights of the chimney gases passing away from the furnace were assumed. This involved the parallel assumption of the value of the chimney losses, which were under 10 per cent. in one case, and slightly over 10 per cent. in

the other case. The difference between the thermal value of the coal burned, and the heat transferred to the steam *via* the boiler, plus the economiser, plus the superheater, together with the assumed chimney losses, gives a radiation loss in the first test of 13·75 per cent., and of 3·1 per cent. in the second case. In the face of the frank admission of the assumed chimney losses, we need not suggest any reasons for querying the latter surprisingly low figure. The second letter, from a firm of manufacturers of mechanical stokers, gives from their experience some sound reasons for discrediting special high efficiency claims, which are either the result of special test runs, or are due (in extreme cases) to errors of observation. Special test runs are interesting scientifically. They may often be magnificent. But are they of real commercial value?

Since writing the above, we have received a letter from Mr. Bennis, but, like the previous one, it comes to hand when we are in the throes of "going to press," and we can here only acknowledge its receipt.

The Charing Cross Co.'s Bow Plant.

With the Institution meeting of Thursday last week, one of the few satisfactory discussions which fall to the lot of a paper before the parent body was brought to a conclusion. Mr. Patchell's excellent reply left far fewer of his numerous critics and querists unanswered than is usual on such occasions.

The meeting was one of those rare occasions when one could gain an insight into the difficulties which beset a London Supply Co. Thus it is interesting to note that Mr. Patchell's company escaped L.C.C. building restrictions, only to be onerously tied by other authorities, not only as to site, but as to the system of trunk mains to be adopted. Luckily for Mr. Patchell, this paternal control did not extend to the type of plant installed; otherwise his efforts to be original in that matter might have been futile.

The discussion produced much conflicting opinion in regard to the suitability or otherwise of the plant adopted; and we fancy that the author's unfortunate reticence on such vital points as capital and working costs left his hearers somewhat unconvinced as to the ultimate commercial value of the plant.

The paper was practically confined to a description of the Bow plant, and sundry developments directly connected therewith; and its comprehensive character clearly precluded any excursions into the realms of figures on that occasion. But, obviously, many engineers with, of necessity, a limited and possibly wholly erroneous idea of the conditions obtaining in the Charing Cross Co.'s area, would be quite unable to form any conclusive opinion as to the value of the plant from the few figures as to performance vouchsafed by the author in the discussion.

For this reason we earnestly hope that Mr. Patchell will find an early opportunity of supplementing his valuable paper on the plant by the equally, if not much more valuable data, which are absolutely essential to a proper appreciation of its virtues.

The conclusion of the discussion in abstract will be found elsewhere in this issue, and a fully illustrated description of the Bow plant appeared in the Electrical Review of December 15th last.

Boiler Setting.

The art of setting boilers upon seatings of brickwork resolves itself in the eyes of the boiler inspector into so arranging the brickwork that practically no part of the exterior of the boiler is not visible to the inspector.

This is accomplished by means of round-faced bricks on which the boiler rests, channels cut across the seats where the ring seams occur, such channels being closed by a loose piece of brick, and by round-nosed bricks where walls merely abut upon the plates of the boiler.

So set, a boiler really is visible all over, and yet no serious short circuit of the gas takes place, for so long as there is contact, the line of contact is made tight by dust drawn into the angle. But when all has been done in this direction, there still remains the consideration of air leakage from the outside. Though at one time sneered at as "finnikin," it is now well realised by men of sense that brickwork and its mortar joints, and its cracks and faults, are very pervious to air, and that such air not only cools the gases as they pass through the flues by dilution, but reduces the heat absorptive efficiency of the boiler plate, and finally so encumbers the flues with an excess of air that the draught is spoiled. All brick walls round boilers are, therefore, properly to be rendered waterproof by tar or paint, and some engineers have called for the removal of the glazed bricks from engine room walls in order that the boiler brickwork may be cased instead with an air-tight cover.

In a recent test, a good result is attributed in part to the complete encasement of the boiler in a sheet-steel casing suitably protected within and without, the steel sheeting rendering impossible all leakage of air.

It seems probable that some of the good results which have for so long been associated with the working of a boiler at a moderate rate have been due to the low power of the draught and the reduced air leakage as compared with what takes place with more powerful draughts. Considering the circumstances in which it works, the locomotive boiler has always shown up well, and this is no doubt partly, perhaps largely, due to the fact that there is complete control over the entry of air. No air can enter except by the ash-pit doors and the fire door. No one really does know how much air gets through a more or less shaken dry brick wall boiler casing.

Gas-Driven Barges.

Apropos of the question of canals, so much to the fore at present, is that of working the barges that use them. In the Thwaite-Cawley system, an electric tractor runs on a post-carried channel bar, and draws a barge by a tow line. A recent suggestion is the suction gas plant carried aboard the barge, and a gas engine to drive a propeller. A barge of this type, fitted by Messrs. Thornycroft with a Capitaine plant, has been taken through the canal from Brentford to Birmingham, thence on to Ellesmere Port and Manchester. The barge carries a double cylinder 35-H.P. engine of "Otto" principle, and a suction producer for coke or anthracite, estimated to give an overall heat efficiency of 23 per cent., using about 1 lb. of fuel per B.H.P.-hour.

The journey was completed last week as far as Birmingham. Six and a half days were occupied on the journey, and though there were mishaps, these cannot be laid either against the gas system or against the idea of canal resuscitation. The mere obstruction of a drowned cat, which appeared to prevent the barge and its towed "butty" from finding room at a lock, was sufficient to cause a delay. The principal use of a canal to some people is the disposal of superfluous cats, and the ropes, cords and twine used in the process may account for the tangling up of the propeller which constituted another difficulty. A suitable propeller guard would have prevented this. The *Duchess* towed, as a test, three "butty" barges for a distance of $1\frac{3}{4}$ miles in 37 minutes.

It required $5\frac{1}{2}$ hours to do $12\frac{1}{2}$ miles and 20 locks, and then it took 11 hours to clear the cooling water pipes from dirt which had collected, because the strainers had been removed. This suggests that the cooling water of the engines should flow in a closed circuit cooled externally by the water of the canal, so avoiding any risk of sedimentation inside the jackets and pipes. The total trip covered 159 locks and $135\frac{1}{2}$ miles, and the fuel consumed was about 15 lb. per mile. The test seems to have shown that suction gas plants may very well be employed on canal barges, but not for a moment should it be assumed that this is a solution of the general problem of canals. Rather, it has tended to prove the utter inadequacy of our present ditches, and to point to the need of enlargement of both canals and vessels.

ELECTRICITY IN THE SERVICE OF THE FIRE BRIGADE.

By FRANK BROADBENT.

That terrible monster, the Daily Press, which, according to modern mythology, captured Electricity in her babyhood, is again reminding us that the captive is still in her infancy.

From time to time we are permitted to learn of some new and interesting development, proclaimed with a fervour paralleled only by that of the fond mother whose offspring has cut another tooth.

"The Thunderer," as the satirist playfully styles the *Times*, has now made the momentous discovery that electricity may be used to drive a fire-pump or to light a searchlight; and makes the bold, but sensible, suggestion that this knowledge might be of immense service to the Fire Brigade.

"It does not appear impossible," says the *Times* correspondent, "to construct suitable insulated cables to transmit the current from a street main in much the same way as the Brigade obtain their water."

The article proceeds: "It is further suggested that the fire engine pumps could be immediately put into motion on arrival at a fire if driven by an electric motor, the power to be obtained by the same means as the light."

These far-reaching proposals, it is interesting to note, have resulted from the employment of electric searchlights at the recent Charing Cross Station roof collapse, when the Electrical Engineer Volunteers rendered such prompt and invaluable service. "The responsibility for this opportune action," and, according to the halfpenny evening variations, also for the germ-idea to harness electricity to the Fire Brigade service, "is generally attributed to Mr. E. Wilmot Seale, the secretary of the Charing Cross, &c., Supply Co.

Mr. Seale, as might be expected, has been waylaid by the interviewer. Among other interesting details, that is, if interviewers are to be taken seriously, the only difficulty Mr. Seale foresees is in "the differences of current in various localities. But," said he, "the engineers could easily surmount these." It only means a little "resistance to reduce the power. In Charing Cross this was effected with some wire wound round the handles of the porters' barrows!" So that although, as the *Times* correspondent says, the proposals present difficulties, "they do not appear insurmountable."

After all, the practical application of the idea is really quite within the bounds of possibility. For proof of this we need but refer to an issue of the *Daily Mail* in May, 1899, in which was described an electric fire engine which had been constructed for the Paris Fire Brigade. But a paper which can describe in harrowing detail a Pekin massacre which, happily, has not yet taken place; which gravely informs us that the Queen has arrived at Calais and will cross to Dover *by special train;* which announces that the *Shamrock* has had several successful trials on the Clyde, and will probably *be launched next week*—a paper with such a record is, perhaps, not taken too seriously when it deals with any matter which is not already common knowledge. It would appear to differ from some of its contemporaries in possessing excessive "lead" rather than "lag," a lead due, probably, to its large capacity for sensationalism.

That electricity has not been more largely used by fire brigades for pumping and searcher work is not due to any want of initiative on the part either of electrical engineers or of fire pump makers. It is now almost 20 years since Mr. J. C. Merryweather investigated the problem of the economical utilisation of electricity for fire engine purposes. So long ago even as this, it was proposed to equip one of the important cities with electrically operated fire-extinguishing apparatus. At that time the efficiency of the electric engine as compared with the steamer, and the ease of manipulation, were not quite considered such as to warrant the adoption of electricity as the motive power, and the scheme was abandoned. Subsequently, however, Messrs. Merryweather and Sons constructed an electric fire engine in order to demonstrate its practicability. This was described in the Electrical Review more than 14 years ago, viz., on December 18th, 1891, page 694.

This electrically operated engine was similar in general design to the steam engines then in use in London and the leading towns in the provinces. The principal difference was that in place of the usual boiler and steam engine for driving the pump, a Siemens motor was used. The pump was capable of throwing 350 to 500 gallons of water per minute to a height of 175 ft. in one jet, to 145 ft. in two jets, or 100 ft. in three jets. The pump was so constructed as to draw its water supply from tanks, streams, shallow wells, or direct from the street hydrants. The current for the motor was taken from the underground mains through a manhole by means of a flexible cable.

The weight of the complete engine, including 1,200 ft. of "double substance" canvas hose and usual implements and accessories was rather more than that of a steam fire engine, but it was easily drawn by a pair of horses at a galloping pace.

This was probably the first electric fire engine constructed suitable for public use, and the above details are given merely to show that what to the daily Press of 1906 "does not appear impossible" was actually done in 1891, or nearly 15 years ago, and that it is not due to any lack of ability on the part of manufacturers to meet all requirements that electrically-driven fire engines are not more generally used to-day.

Details of an electric fire engine made by Messrs. Kummer, of Dresden, were given in the *Electrical Engineer*, of New York, of April 6th, 1892. The motor consumed 5,000 watts, or about 7 E.H.P. The duty of the pump was given as 180 cb. ft. of water per second (?), and it threw to a height of 100 ft. through a $\frac{3}{4}$-in nozzle. The weight was $2\frac{1}{2}$ tons, and the cost only about half that of an ordinary steam fire engine.

The same journal in November, 1895, described and illustrated an electric fire engine designed by Birkett and McElroy, of Brooklyn. The arrangements were such that the motor could be driven from the underground system of mains by means of a flexible cable, or from the overhead trolley wire of an electric tramway system. In the latter case a metal pin is driven into the ground alongside the track rail to carry the return current. This is a method of working which might not appeal to the "powers that be" in this country. Illustrations are published which show the various methods of connection, including one in which the return connection is made to the earthed conductor in a street pillar.

The motor is supported at the rear end of the engine frame and drives the pump by means of worm gear. An abstract of the description is given in the Electrical Review, December 6th, 1895, p. 710.

Coming to more recent times, a short description, abstracted from the *Scientific American*, will be found in the Electrical Review of June 12th, 1903, p. 1013, of an electric fire engine constructed at Rouen.

In this case the pump is coupled direct to the motor running at a speed of 2,000 r.p.m. The electrical arrangements are such that current can either be taken from the overhead trolley wire or from the lighting mains. In the former case connection is made to the trolley wire by means of a contact carried on a light bamboo rod, the return connection being made by means of a cast-iron block placed on one of the tram rails.

The flexible cable is carried on a reel above the motor, and the whole apparatus is arranged on a two-wheeled truck, the hose being carried in a separate cart coupled to the fire engine.

Referring to the use of searchlights for fire brigade work, a very novel application was recorded in the Electrical Review, of October 18th, 1895 (p. 483). In this case the searchlight was used not to assist in extinguishing, but to prevent fire. In consequence of riots in connection with a strike at Messrs. Gartside's works, near Stalybridge, a ship canal searchlight plant was fixed on the roof of one of the buildings with the idea of preventing the strikers from setting fire to the temporary sheds erected for the protection of the men employed in place of the strikers. The searchlight was used nightly in conjunction with a special police force—which it was possible to reduce considerably in consequence—to scour the country and to illuminate the places where pickets were stationed. The searchlight plant was erected and set to work by Messrs. Baxendale & Co., of Manchester, within a few hours of instructions having been

given, and it is believed to have been instrumental in preventing incendiarism.

Electric searchlights were used by the New York Fire Department as long as six years ago. A note in the *Scientific American* in November, 1899 (*vide* Electrical Review, Vol. 45, December 1st, 1899, p. 892), described a new searchlight wagon which had been added to the equipment of the Department. In appearance it resembled an ordinary fire engine, but, instead of pumps, it was equipped with an engine and dynamo and two searchlights each of 18 in. diameter, the latter being mounted on a platform behind the driver's seat. They could be used either in this position or removed to a point of vantage, current being led to them by means of flexible cables. For lighting up the fronts of buildings in which people were in danger, and for illuminating dark parts of streets, and so aiding the firemen in laying hose, setting ladders, &c., such an apparatus must be of immense service.

There is, obviously, no question as to the possibility or practicability of using electricity for searchlights and pumps in connection with fire brigade and salvage corps operations, and any demand for such apparatus can be easily supplied.

The chief difficulty is in obtaining a supply of electricity near the scene of the fire. There would, of course, be no advantage in carrying a portable electric generating plant on a fire engine for the purpose of driving the pump electrically. What is needed, if electric pumping is to supersede the steam pump, is that an electricity supply should be as readily obtainable as a water supply, and for this purpose steel connection pillars will be necessary near every fire hydrant. A standard pattern of connector would also need to be adopted universally. Motors fitted with double commutators to take either 240 or 480 volts would meet most requirements, as the pressures on public supply mains are now rarely below 200.

For projector work the conditions of public supply are not so well adapted, owing to the low pressure and large currents required. It will probably be more satisfactory for this work to use a portable generating plant—driven either by steam or petrol. As portable plants for arc lighting are in common and satisfactory use for merry-go-rounds, there should be no difficulty in designing a suitable pattern for fire purposes.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Tantalum Lamps.

I have read the inquiry from Messrs. Bagguley & Woods on the question of life of these lamps when run in series, and can supply the remedy for their troubles.

The cause of premature failure (which I also experienced when first using these lamps) is the uneven current consumption, even when the lamps are ordered specially for running in series.

By adopting the following course, I have obtained good results :—

Wire two lampholders in series, and put a voltmeter across one. On receipt of a batch of lamps, sort them out so that with each pair the same reading on the voltmeter is obtained when the lamps are crossed over. Then tie the two wrappers together, and see that the lamps are used together. When one lamp of a pair fails, take out both, and put the partly-used one into stock until several are laid by ; then sort out the old ones as before, and use them in pairs for renewals. The same, of course, applies to all lamps run in series—osmium, tantalum, or ordinary lamps for car lighting.

Where facilities exist for obtaining the half, third or other fractional voltage, of course, the sorting out can be done by simply measuring the current and marking it on the lamps ; and I myself think the makers should do this in all cases where lamps are ordered for series running. I think the osmium lamps are so marked, but not the tantalum. It must be remembered, however, that when one fails the remaining lamps must be re-marked or re-sorted, as their resistances have altered in use.

If the makers would send out the lamps properly paired for series running, it would help the ordinary consumer to appreciate the lamps at their proper value on high voltage circuits ; but, after all, we must wait for high voltage lamps and a fair allowance for old lamps before there will be any large sale to ordinary consumers on high voltage circuits at the present prices.

After all, if it is the osmium or tantalum which makes the lamps so dear, the makers could afford to allow a fair price for old lamps ; all the metal is still available, and there is, to my mind, no reason why the lamps could not be sold at, say, 2s. to ordinary consumers if the old lamps are returned intact.

W. Fennell.

Electricity Department, Wednesbury,
January 13th, 1906.

Protection in Excelsis.

With reference to Mr. Frank Foster's letter *re* Protection in the last issue of your paper, the writer would be glad to have information on the following points :—

Why did Mr. Foster take it for granted that if we purchase a machine tool in England, there would be fewer mechanics making cotton machinery, when there are so many unemployed mechanics who could make the tools without affecting the cotton machinery industry ?

I follow his argument about relative prices, but will he be good enough to inform me which class of staple products are higher in price in Germany than in England ?

Will Mr. Foster also say whether he considers efficiency of production in any way prejudiced or influenced by the size of the market ?

Perhaps the replies to my questions may be some part of the modifying features that Mr. Foster speaks about, and as I am merely the London representative of a British firm of manufacturers, I am naturally very anxious to have all the information I can.

Ignoramus.

I should like to have a few words in reply to the arguments for Protection put forth by "Retaliator" and "Jaybee."

"Retaliator" claims that the German manufacturer has a market which is larger than ours in the ratio of 9 to 4, due to his export trade to England. This statement is incorrect. Taking the years 1900, 1901 and 1902—the last years for which I have complete figures to hand—we see that the total value of the exports (without ships) from England averaged £343,000,000 per year, or £8·4 per head, as against £229,000,000 from Germany—including ships in this case—or only £4·1 per head. Even if we deduct re-exports from the English total—and I have no figures for German re-exports—the figure only falls to £277,000,000, or £6·8 per head. So that whichever way we look at the matter it is evident that England has a larger foreign market than Germany, and the same holds good as regards all other Protected countries, not excluding the United States. The trade returns for the last few years show still better results, and in most cases we export twice as much per head as the Protectionist countries.

"Retaliator" states "that it is *quantity* which means cheapness," and by quantity he here refers to the size of the market. As a general rule this statement is quite incorrect. It is quite true that a firm manufacturing, say, 100 electric motors of one size per week can make them cheaper than it could two or three, but this has very little to do with the size of the market, provided the market is reasonably large. In any industry there are a large number of firms trying to make a profit. Many fail and drop out, so that only those are left who can—or have reasonable hopes of so doing—make a profit. If, now, we shut out the foreigner, and leave the home market to the home firms, then these failures—or their equivalents—have to be brought to life again ; but they cannot do so unless the price is raised, and hence we see that quantity in the sense used by "Retaliator" does not mean cheapness, but just the reverse. "Retaliator" knows perfectly well that if the home producers could

produce all that we consume at home at the ruling market prices, they would do so. It is only because many of them cannot do so that we have resort to the foreign-made article.

That there should be a great outcry when a British contract goes abroad is really foolish, save that such outcry may induce the home manufacturer to bestir himself. If it pays us better to manufacture cotton for export in payment for imports of, say, electrical machinery, then why on earth should we be such fools as to desire to make electrical machinery instead of cotton?

If a certain trade declines under Free Trade—or free imports—that is not in itself a matter for regret. If the decline were meteoric in its rapidity—which it never is—there would be a serious loss of capital and dislocation of employment; but a steady decline is not attended by these features. It is, indeed, mainly a stoppage of growth, together with a decent burial for the weaklings who go to the wall in every industry, even in good times.

As for "Jaybee," his fallacious ideas are too numerous to mention, but I would remind him that *goods*, not money, constitute wealth, and that the rapidity of circulation of the money does not affect the wealth of the country, although the greater this rapidity, the less money there is in the country.

Frank Foster.

Manchester, *January 14th*, 1906.

After reading the interesting correspondence on Protection in your issue of the 12th inst., I would like to ask Mr. Frank Foster if he considers that the Germans, French, Americans and other supporters of Protection all have the same ridiculous notions, which he states are shared by Protectionists in this country? Does he also suggest that Free Importers are the only wise people on the face of the earth? Why, Sir, it must be plain to even the most narrow-minded, that there is something in favour of Tariffs by the very fact of these other nations adopting it, and moreover prospering under it, when, according to the statements of Free Importers, they ought to be ruined.

Cobden in advocating Free Trade, naturally concluded that other countries would accept our goods duty free in return for the Free Imports which we offered them; but they did not do so, and it is surely time that we made some change in the ridiculous system which now exists.

Mr. Foster would like to know, he says, how foreign competition displaces labour. He must know that if we buy, say, rails from Belgium, the labour of that country has been employed in making them, and it naturally follows that British workmen have lost that amount of work.

It is for the workmen to say if they are contented under so-called Free Trade, to see such a large number of their fellow men out of employment, and if they do not vote for a change at the present election, I feel sure that they will do so in time, when unemployment has increased and the facts are more apparent to all.

This will be the time when our Colonial markets—the greatest in the world—are gone, and which side does Mr. Foster think the people will vote for then?

Free Trader.

It is surprising to me that there are men connected with the great electrical construction works in the United Kingdom who are followers of Mr. Chamberlain on his fiscal policy. May I be allowed to put before your readers reasons which, I think, are worth consideration, and which may appeal to practical men of business?

Mr. Chamberlain says that he will let in raw materials free, and for this we are duly grateful to him; but he proposed to put a tax on American wheat, with the object of stopping its importation in favour of Colonial wheat. He takes it for granted that the Americans will quietly submit to this, and take it lying down. Had the position been reversed, I take it that Mr. Chamberlain would not have taken it "lying down," but having received a slap on one side of the face would not turn the other, but have done that which would be more in accordance with human nature—viz., hit back with all his might.

This brings me to my point. America is the largest producer of copper in the world. Her output is over 400,000 tons per annum, and, as compared with her, the rest of the world is nowhere. In looking about her for a means of hitting back hard, is it not highly probable that she would give a thought to necessary articles which she supplies to us and which we cannot get elsewhere! Mr. Chamberlain would do so, I am quite certain.

Our magnificent trade in electrical cables, &c., employing many thousands of workmen on the Thames, in Manchester, Liverpool, Glasgow, &c., and which, as you, sir, admitted to me the other day, is the greatest in the world, depends on American copper.

Suppose, therefore, the Americans said in reply to Mr. Chamberlain's action: "We will stop him getting his raw copper free by putting on a 10 per cent. export duty," how would that affect the electrical construction trade? It would in a very short time divert it to America. I ask your readers to calmly consider this view, and put it to themselves whether there is not something in it.

I might follow the same argument in cotton, but need not do so, as in this we depend even more than we do in copper, if that is possible, on America.

Jas. Forster.

London, E.C., *January 12th*, 1906.

My friend "Retaliator" knows that, fiscally, I am not in the habit of taking things lying down, and he must, therefore, be prepared for one or two obvious rejoinders to the fallacies in his attack on my article.

First, we have that old and thread-bare "restricted market" cry. The answer is that, taking external trade only, the United Kingdom's engineering exports in 1904 were £58,507,000, while in 1904 the German engineering exports were £26,487,000. The trade ratio externally is not nine to four, as "Retaliator" suggests in favour of Germany, but 58·5 to 26·5 in favour of the country which does not yet enjoy (?) retaliation.

Secondly, "Retaliator" might do worse than read Mr. Cowan's inaugural address to one of the local sections of the I.E.E. of a year or two back. If he soberly believes that imports into the country are not either the products received in exchange for direct exports, or the income on foreign investments, reaching us often in an indirect way, I would suggest his changing his recreative literature, which, I believe, includes some popular ½d. morning papers, and the writings of Haeckel and Thomas Hardy, for a few months of Mill, Ricardo, Guyot, or even the much decried Adam Smith.

As to the opposition to protection (or retaliation) for man, we Free Traders can match Free Trade manufacturers against those crying out for protection. If those of us who have not attained fame as manufacturers are to be attacked as the creators of bogies, we can at least point to the fact that an ex-screw manufacturer, and an active electrical accessories manufacturer, had endeavoured previously to make our flesh creep with their jeremiads. As to the experience of practical men against the knowledge of those who have studied the natural laws underlying the case, I could, on the authority of a past president of the Institution, tell a pretty story, and myself deduce a pretty moral therefrom. For the moment, I refrain.

But, Mr. Editor, I seek the protection of your columns, not fiscally, but morally, for myself. Could any traducer of a brother electrical engineer say a worse thing of a friend who is about to pay his ninth subscription to the Institution, than to insinuate that he "has had some experience . . . . in the manufacture of gas." Apart from any dubious *double entente*, I am calumniated by a friend. Sir, I have never manufactured for sale a single cubic foot of any gas, illuminating or stupefying. I have, however, experienced the inexorable nature of the laws of supply and demand in regard to the electrolytic manufacture of solutions of certain gases and certain metals. But this is a different matter from "Retaliator's" insinuation. As to the particular product in question, I do not complain, because of the action of the laws of supply and demand. As to the branch of industry being entirely in German hands, "Retaliator" is misinformed.

With regard to "Jaybee" it is easy enough, in the guise of anonymity, to question my understanding of the subject. In my article I did not mention Mr. Chamberlain's name, although in my study of Mr. Chamberlain's *dicta* on the question I have taken the *Times* versions. I am quite aware that, nominally, the taxation of raw material did not form part of the official protectionist programme. But what constitutes raw material? Will "Jaybee" do me the courtesy of re-reading my article, and then tell me, in the cases I cited, what is and what is not a raw material? Will he also tell me, if he advocates Colonial preferences, how these are to be secured without the granting of preferences on certain raw materials? Will he also tell me whether he believes that external commerce is advantageous to a country? Or is he prepared in his devotion to worn-out methods, absolutely inapplicable to a country situated so uniquely as the United Kingdom, to hark back to the days when the man of the Stone Age perforce held the position of hereditary jack-of-all-trades to himself?

W. Pollard Digby.

London, W.C., *January 16th*, 1906.

One of the most hopeful signs of the times from a Tariff Reform point of view is the change of attitude shown of late by the exponents of Free Trade, who are finding that the Protectionist movement has to be taken seriously, and that its arguments have to be met with logic in place of dogma and ridicule.

This change of front has entailed, however, the loss of some of the most interesting of the Free Trade arguments, so that it is a real pleasure to meet again an old friend brought forward by your correspondent, Mr. Foster.

He challenges a statement of mine with the old argument that imports must encourage exports. If we suppose, for the sake of argument, that this is strictly true, is it necessary to point out that manufactured imports do not necessarily encourage manufactured exports? German motors may be paid for by Welsh coal. A little consideration shows that:—

1. It is to the interest of a country to export manufactures and import raw material.

2. A protected country dealing with a free trade country has the power to choose its trade to a large extent.

It is not surprising, therefore, that official figures and common observation alike show that our exports are becoming less highly manufactured and our imports more so.

And then Mr. Foster thinks foreign competition does not displace British labour.

The second part of the letter in question is an awful example of the error into which one may fall in dealing with pure theory, alike in politics as in mathematics.

The author of your correspondent's Political Economy book has forgotten the tariff.

Without reference to exact figures let us take an example to fix ideas.

Suppose a motor sells in Germany for £110 and a gas engine for £120, while here they both sell for £100.

A motor is sent over here, and, according to Mr. Foster, there will a tendency for a gas engine to gravitate toward the Fatherland in payment.

On receiving that engine the German firm pays, say, £40 duty, and must, therefore, sell at over £150 to make the transaction worth while. To sell at all if there is serious competition the English firm must have dropped their price to say £60.

The figures are quite unimportant; we are dealing with general principles, which will be the same if the effect is great or small.

Mr. Foster's example holds good for two Free Trade countries; but an inequality, such as at present exists, upsets the natural flow of trade and gives the protected country the best of the bargain.

G.

Mr. Pollard Digby's article on "Protection in Excelsis" is disappointing. He promises us at the outset "a few words on the engineering side," but finishes in the good old style of political hustings, with catchwords such as "goodwill, peace and prosperity," and he dilates on the cry of lobbying and corrupting our Parliament—a cry which is contemptible, but, as events have proved, has its value in election times. It is, however, not Mr. Digby's article, but Mr. Frank Foster's letter which induces me to write to you.

He asserts that foreign competition does not displace labour, because we pay for the goods which we import by the goods which we export, or, in his own words, "If America sends us a machine tool, we pay for it by cotton machinery." This is the orthodox Free Trade position, and I believe I have the concurrence of the Free Traders when I say that the whole question of Free Trade must stand or fall on its truth or untruth.

Free Traders have accepted this axiom, first brought out by MacCulloch more than 60 years ago, as a law immutable: and upon it rests their whole belief and assertion that Free Trade cannot cause unemployment. Still, Mr. Foster cannot deny that the question "how we pay for our imports" is a matter of fact and not of theory.

We have some facts to go upon. We know that our imports exceed our exports by at least £200,000,000. Free Traders themselves acknowledge that this is covered half by shipping and commission services, and half by interest on foreign investments. The latter are computed at between 65 and 100 millions per annum. I think 80 millions may be taken as nearest the mark.

Now, payment of imports by interest cannot provide labour. It is evident that foreign imports must displace labour in England to the amount of 40 millions on this head alone (assuming that half the value of goods is expended in labour). The payment of 40 millions a year of extra wages in Britain would, at the present time, make all the difference to our working classes.

The next point I wish to consider is whether we pay part of our imports out of capital.

I know there is no adequate data to prove whether we do or do not; but that we are very near the line, and drifting towards that dangerous position, there cannot be a doubt. Should we have to touch capital to pay for part of our imports, every sovereign would displace at least 10 shillings-worth of labour.

The third point to consider is this: To pay for imported goods and services by goods and services may still displace labour in case the value of labour represented by exports is less than the value of labour in imports.

A Bechstein piano sold to us at £100 may be paid for by a £100 worth of cotton cloth—which of the two is more profitable to labour? Take Mr. Foster's instance: An American machine tool may represent £20 of raw material, £50 of labour and £30 of salaries and profit, we may here take profits as the payment for the labour of the capitalist. The English cotton machinery may represent £40 of raw material and £60 of labour and profit. In this case British labour would have been displaced to the extent of £20. Of course, the question that now arises is this—Which represents more labour and profit, the goods which we import or the goods which we export? Free Trade theorists have thought of that, and believed that they could settle the question by enunciating an axiom—"That a nation makes that cheapest for which it is best suited." But facts have proved that this theory won't wash. It is the object of Protection to regulate duties in such a way that only articles may be imported which are least profitable to make at home.

We under Free Trade do not attempt to regulate our imports, and the logical result must be that we shall be left to produce the most unprofitable commodities—"The hewing of wood and drawing of water."

I do not affirm that this state of affairs exists at the present time; we may even possess the advantage. It is a question of facts, but it would inevitably come to this if we were to continue our Free Trade policy, an outlook which I refuse to contemplate even with the echoes of the elections in my ears. It is wrong to believe that no labour can be displaced, provided goods of a certain selling value are exchanged with goods of equal value arrived at by fortuitous circumstances, such as supply and demand, commercial push, &c.

Mr. Foster affirms that some "principles of international

trade" exist which would preclude foreign competition from displacing labour. I say that no such principle does exist, except in the brains of economists of the Manchester school, who mistook the occurrence of passing events for immutable principles of trade.

G. Byng.

Boscombe, *January 16th*, 1906.

I should like, with your permission, to commend your correspondent "Jaybee" to the careful consideration of the very enlightening and logical letter from "Frank Foster," which immediately precedes his in your issue of the 12th inst. Mr. Chamberlain and others have said that America and Germany do not tax raw material, but this is not strictly correct. No doubt some things are exempt, but certainly not all, and only recently the tax on hides has been raised (to conciliate the meat trusts), much to the disgust of the American boot manufacturers, one at least of whom has said that if only his raw material were admitted free, he could defy the competition of the world, and as can be seen by the cartoons, the consumers are kicking, as is, of course, only natural, against the higher price of boots that inevitably follows.

With regard to Mr. Chamberlain's proposal not to tax raw material, I should like to know how "Jaybee" explains his reply to a correspondent, stating that he would propose to allow a rebate on leather to those manufacturers exporting boots, &c., and if the producer pays the tax, why should there be any rebate at all? Does not this prove that it is the consumer (in this case the boot manufacturer) that even in Mr. Chamberlain's opinion would have to pay the duty (on leather)? But perhaps "Jaybee" does not regard leather as raw material, and would only class raw hides as such! The great mistake made by such exponents of the virtues of Protection, as he seems to me to be, is that they overlook the fact that if goods are not imported the goods that were made at home to pay (exchange) for such imports would no longer be required, and that consequently if certain goods now imported are made at home, and so more workers (in that particular line) are employed, a more or less corresponding number of workers in some other line must be thrown out of employment, for to assume the contrary is to assume that the home market is inexhaustible, and that in the case of, say, boots, there are purchasers going shoeless now who could, and would, buy up all the boots now exported; if this is so, our manufacturers must be very wanting in business acumen and energy to allow so large a market at their very doors to go unsupplied. The shipping trade, too, would inevitably suffer. Another evil of making everything at home which can be made more cheaply and satisfactorily elsewhere, is that more would have to be paid for the article, which is an obvious waste of good money; foreign competition keeps prices down to a healthy level (to the great benefit of the poor consumers who otherwise would be at the manufacturers' mercy), just as competition in the same town or street does, and referring to a remark of Mr. Byng's, I would reverse his question and inquire where we should be if the foreigner did not send us carbons? If price were no object at all we could grow "grapes on Snowdon" instead of importing them, as Sir John Jenkins remarks, to whose excellent and enlightening articles on the "ruined" tin-plate trade, in the *Westminster Gazette* of the 10th and 12th inst., I would confidently recommend all your readers, and in particular such as "Jaybee," whose letter does not convince me that he is more competent than Mr. Pollard Digby to write on the subject.

As to the unemployed, one would think, to hear some Protectionists talk, that they were peculiar to Free Trade countries instead of a world-wide trouble; upon this also considerable light is thrown by Sir J. Jenkins in the articles referred to.

A Staunch Free Trader.

[The urgency of this question has now passed away, and as we are unable to afford the necessary space for its discussion, we think it had better be dropped.—Eds. E.R.]

Electric Haulage on Canals.

It may, perhaps, be of interest to your readers to know that the system of electric haulage on canals, described in your issue of the 12th inst., was fully explained by Mr. T. Commerford Martin, the well-known American electrician and an authority on canal haulage systems, in the *Electrical World and Engineer* of November 14th, 1903. The method is there described as resembling that of the Thwaite-Cawley system, of which this company holds the rights of the master patent of 1894.

N. Embleton,
Secretary, The Electric Canal Haulage Co.

Westminster *January 15th*, 1906.

[The Thwaite-Cawley system was also described in our issue of September 30th, 1898.—Eds. E.R.]

Thermal Efficiencies.

My attention is drawn to Mr. Bennis's letter in your current issue. It is really very good of Mr. Bennis to quote me in support of his unsupportable figures, but when the facts are known his curious methods will become apparent.

Some time ago you published a letter signed by one "Calories." It was a well reasoned letter dealing with figures that had been published relative to a so-called test of a boiler to which there was a Bennis stoker. The figures were obviously wrong, and "Calories" incontrovertibly showed this. Had I written that letter my name would have been signed to it, for it showed that the writer knew of what he was talking. But I did not write or instigate it, nor do I even yet know who did either of these things. But the writer was your "irresponsible scribbler," and ever since that time I have been pursued by Mr. Bennis and his representatives, who have gone about declaring me to be the writer of anonymous letters about them or their products.

Now though I have no grand opinion of the winnow and spring rat-trap combination by which, so far with not unalloyed success, Mr. Bennis essays to produce fires of even thickness, I do not know that I have ever said or written anonymously anything against Mr. Bennis or his stoker as such.

Mr. Bennis has refused any explanation of his doings, yet he continues to ascribe your recent leading article of January 5th to the same "irresponsible scribbler," whom he has publicly averred to be myself, though, I say it with regret, I am again ignorant of the writer of that excellent article which dealt with a gross abuse in a very temperate manner. By the light above, you will now be able to perceive the irony of Mr. Bennis quoting my test of the Davies patent boiler to support his own impossible figures. I strongly decline to permit this impertinence.

Now for facts of tests. On March 16th, 1905, Mr. Bennis quotes a test of a Lancashire boiler at Messrs. Firth and Sons, of Brighouse, burning 34·6 lb. per sq. ft. of grate per hour, and he gives the boiler efficiency alone at 88·1 per cent., with a boiler pressure of 81·2 lb. (See Mr. Bennis's Red Pamphlet distributed at the 1905 Tramways Exhibition, p. 11.)

My test of the Davies boiler had, from circumstances, to be carried out at 77 lb. pressure. It was carried out on a boiler with a brick-lined, air-tight case, asbestos covered. There was a firebrick-lined roomy combustion chamber, with regulated air admission, on the principle I have long advocated as necessary for good combustion. The coal was clean Admiralty test Welsh, burned at 14 lb. per sq. ft. per hour, not at the high rate of 34 lb. The boiler was new and quite clean, yet I only obtained 86·342 per cent. efficiency for boiler, superheater and economiser, or some 2 per cent. less than Mr. Bennis's 88·1 per cent. *for boiler alone!!!* This he calls a support of his impossible case.

At the time of "Calories'" letter, I wrote you on the "Real Efficiency of Boilers," not anonymously, the real efficiency being the ratio of heat absorbed to the heat *supplied above boiler temperature.*

My figure for this, for the Davies boiler, was 88·91 per cent., or but little more than Mr. Bennis's efficiency as usually stated. *His* "real efficiency" was a long way over 100 per cent.!!!!

My efficiency, as usually stated, was apparently only 81·28 per cent., but I took care to state that part of this was due to drying of the priming by the superheater, so that the actual efficiency would be a trifle less than 80 per cent. Thus my figures are practically 10 per cent. below the impossible figures given by Mr. Bennis. My test was carefully carried out, and my figures have the support of my colleague, Mr. H. Wall Wilkinson, who helped me on the test, and on whose carefulness and accuracy I have great reliance.

If Mr. Bennis wishes to run amok against your "irresponsible scribbler," let him smell the witch out, and leave me alone; and I would further advise him to study the principles enunciated by Rankine, Joule, Maxwell and other authorities on heat, to remember that heat cannot pass from a cold to a warmer body, and, if he would escape the lash that seems to have warmed him to such temper, let him submit his test figures to even an "irresponsible scribbler" before publication. "It wad frae mony a blunder free him, an' foolish notion." When he has intelligently comprehended the above principles he will have found a key that will unlock the door he howls without.

Mr. Bennis is on record, so long as paper will last, as having claimed 88·1 per cent. of efficiency under the conditions I have named, "and, having let his pen write, nor all his piety nor wit shall lure it back to cancel half a line." This ought to sober his future conduct, and hold him back from attacking his elders who have learned by experience that even under test conditions 80 per cent. is about a limit for any boiler efficiency, not to mention such conditions as appertained to his claim of 88·1 per cent. Mr. Bennis chooses to refer to the third place of decimals in one of my records as evidence of the carefulness of my test. Had he known so much of me as his "discoveries" would warrant the supposition, he would have attributed this to my use of Fuller's slide rule, which usually gives five figures, and he ought to know that, in order to preserve statistical consistency and avoid cumulative differences, test results are marked out to an accuracy far beyond the accuracy of instrumental observation and personal error. Even at my age I would not claim accuracy to the first place of decimals.

Wm. H. Booth.

London, *January 12th*, 1906.

P.S.—Seeing that my figures have thus been dragged into public view, may I request that the short report, of which I enclose you a copy, be printed by you *in extenso*. It has, at least, the merit of being probably the first report of a test in which an effort is made to distinguish between the nominal and the real efficiency of a boiler.

[We refer to this matter in our leading columns.—Eds. E.R.]

As English manufacturers of mechanical stokers, we have never concealed our conviction that 80 per cent. thermal efficiency is the maximum either desirable or commercially practicable, for the following simple reasons :—

When working boilers at a fair rating, the temperature of escaping gases will be fully 400° F., even if both superheater and economiser are used. Therefore, if the furnace temperature is as high as 3,000° F., the heat loss in escaping gases at 400° is 13·3 per cent. ; and if the other heat losses in radiation, in ashes, &c., do not exceed 6·7 per cent., a thermal efficiency of 80 per cent. is possible. But in most cases, 70 per cent. to 75 per cent. efficiency is very good work ; and when the type of stoker is unsuited for regular working at 3,000° furnace temperature, the normal efficiency must be lower still.

Of course, most stoker experts can force combustion for a test of a few hours, and by getting a furnace temperature at, say, 4,000°, can show a test efficiency of a most misleading character, for forced rates of combustion and excessive temperatures like 4,000° involve such prohibitive working cost and depreciation that in normal working nothing approaching such test results is practicable.

We have consistently refused to make guarantees of efficiencies which are only possible during brief tests ; and we lose no opportunity of impressing on steam users that what they need is evidence of actual nett money-saving under regular working conditions, and that tests made under abnormal conditions are valueless and misleading, even if they are correct.

Of course, errors are frequently made in good faith ; and we have a fine collection of tests showing impossible results, but in most cases the cause of error is quite easily traced. Users of Erith's stokers have sent us their own tests, working out, for instance, at 91·4 per cent. and 93 per cent. efficiency ; in all such cases we have pointed out the impossibilities of such results, and have found the true efficiency to be about 75 per cent. Our foreign and Colonial licensees report similar experiences ; and, of course, the nationality of a user has nothing to do with a question of utilisation of heat.

A very important point is that the simplest and most durable stokers do everything that is practicable in combustion ; therefore there is no occasion for complications with their attendant working and repair charges.

The wasteful steam-jet furnace appears almost every week as a new patent, either as a means of forcing combustion or of preventing smoke ; such steam jets cost more to work than they can save. Mechanical fan-draught is, however, desirable, as it gives a positive control over the air supply ; and for a moderate rate of combustion, the working cost of fan draught is quite nominal.

It cannot be two widely known that forced rates of combustion are undesirable and unnecessary, especially for the efficient and smokeless combustion of cheap coals. All that is needed is sufficient furnace area ; then, provided proper methods are employed, there is no difficulty in getting the full steaming duty out of a boiler consistently with the smokeless and economical combustion of cheap slack coal : but, on the other hand, if (as frequently happens) the boiler furnace is only just large enough to get its rating by burning best Welsh coal without regard to the smoke question, then it is simply absurd to expect mechanical stokers on the same furnace to do the same duty smokelessly with much inferior coal. Where practicable, the boiler furnaces should be widened ; otherwise, if smokless and efficient combustion of slack coal is required, the boiler capacity must be lower than if best smokeless coal were used on the same furnace area.

We would point out that the power station engineer who binds the contractor down to extraordinary efficiencies on tests, gets no real security. If the contractor knows his business, he can make a test that will fill his guarantee, although in everyday working the results must be altogether inferior, hence everyone knows of stokers paid for and then thrown aside as worthless.

The only real security for the power station engineer or other steam user is to understand for himself the simple principles involved in this question of thermal efficiencies ; to disregard extravagant claims and paper guarantees and misleading test figures ; to see that his boiler furnaces are large enough for the smokeless and efficient combustion of the class of coal in view, in relation to the steaming duty actually proposed ; then to find out and buy the mechanical stokers, which are simple, durable, smokeless and efficient under normal commercial working conditions.

Erith's Engineering Co., Ltd.,
Charles Erith, *Director.*

London, *January 13th*, 1906.

The attitude assumed in your "Note" of the 12th on my letter published in the same issue makes it advisable that I should define what I mean by the thermal efficiency of a steam generating plant. I will do so as briefly as possible consistently with accuracy.

Let w = No. of lb. of coal consumed during a test.
W = No. of lb. of water evaporated during such test.
C = calorific value of the coal used in B.TH.U.

per lb., *i.e.*, the total number of B.TH.U. produced by the combustion of 1 lb. of coal in air, all the products of combustion being reduced after combustion to the original temperature of the air, excepting the H_2O, which remains as steam at 212° F.

H = total heat, in B.TH.U. per lb., of the steam as it leaves the steam generating plant, whether dry, wet, or superheated ; this total heat being calculated from water at 32° F.

h = total heat, in B.TH.U. per lb., of the water as it enters the steam generating plant; this heat being calculated from water at 32° F.

E = thermal efficiency of plant.

Then $$E = \frac{W\ (H - h)}{w\ C}.$$

The only quantities which need be known in order to calculate the thermal efficiency are w, W, C, H, h. These we determine as follows:—

w. By direct weighing of all coal supplied to the boiler. The fires are brought at the end of the test to as nearly as possible the same state as at the beginning, and the test should be continued for a sufficient duration to reduce the maximum possible error which might be caused by more or less coal lying on the bars at the end of the test than there was at the beginning to not more than 1 per cent.

W. By direct measurement of the feed water supplied to the steam generating plant, either by a reliable and tested meter, or, preferably, by a tank or tanks. To secure the greatest accuracy, the water level in the boiler, the steam pressure and the rate of evaporation should be the same at the beginning and end of the test.

C. A sample of the coal used for the test is taken, by removing a small quantity from each coal weighing, or by any other well-known method of sampling. This example is ground up and about 1 gram is burnt in a calorimeter. We use the "Darling" calorimeter, but, whatever your leader writer may say, we are always prepared to submit the coal sample to any analyst selected by the engineer at whose works the test is being made, and as you will have noticed in several of our published tests this has been done.

H. The pressure and superheat, if any, of the steam leaving the steam generating plant, are observed at half or quarter-hourly observations, and H is deduced from the average of these observations by consulting Clark's, Peabody's or any other well-known steam table.

h. The temperature of the water entering the steam-generating plant is observed at the same intervals as above, and h is then deduced in the same manner as H.

Having given this very brief sketch of the methods adopted by my firm in observing the data of tests of steam-generating plants, and in calculating the efficiency therefrom, I leave these methods to be "shot at." I can only say that no one can be more thankful than myself for any *sensible* criticism which would tend to make known more accurate methods; but mere vague expressions of distrust and insinuations of wilful bad faith do nothing but waste everybody's time—your own, mine, and your readers'.

You state in your note that "my good faith was not, and is not, in question." But when, after referring to results given in a paper by myself, you say ". . . . the calorific value of the fuel (taken by a selected calorimeter)," I am certain that 99 people out of 100 would take you to mean that I, or someone else on my firm's behalf, had carefully selected a calorimeter which read lower than the truth, in order to raise the thermal efficiency to a fictitious value. If the "selection" had been made for the greatest accuracy it would not be referred to in an article impugning the accuracy of the result. And if a "selection" for the greatest inaccuracy is not "wilful bad faith," I do not know English.

You are very severe because we do not give the precise allocation of all the heat which did *not* go into the water. Now, I am far from denying that such complete heat balances are valuable, very valuable, for purposes of research and for indicating where to look for the means of improvement. But I contend that it is not possible, *commercially*, to go to the great expense of a test which could yield such a heat balance every time that we make a test to prove that our performance exceeds our guarantee. And I also contend that, provided the five quantities enumerated above are correct, the absence of any further information makes no difference whatever to the reliability of the efficiency deduced from those quantities.

I enclose a copy of the official form that we have adopted for our steam boiler test reports. This form will indicate to you the data which we aim at observing, as far as possible, in any one test.

We have done with philosophic doubt in Manchester, as you will see from the results of the elections, and we are sorry to see the same old (Fair Trade ?) fallacy raised.

If X saves 80 per cent. of steam, then Y's patented governor, which saves 20 per cent. of steam, causes the engine to run itself, and so we get Poleforcia.

The compressed air furnace is *not* forced draught, the flue under the bars is not closed, and all we do is to balance the draught and provide air adjustment. The words "forced draught" are invariably taken to mean an arrangement in which the air for combustion is forced into a closed space: as this is not the case in our compressed air furnace, it would not tend to accuracy, but the reverse, to describe it as forced draught.

We would not guarantee 85 per cent. efficiency, but I believe that it has been obtained under exceptionally favourable conditions. I am certain that any firm supplying only the dynamo in an electricity station would absolutely decline to guarantee that the highest attainable efficiency would be obtained all the way from the coal heap to the switchboard. We are in an analogous position.

Mr. "Philosophic Doubt" ends his surprising letter by asking that we should act as honorary consulting engineers through the Press; it is obvious we cannot extol any one of the makers of good superheaters, economisers and other accessories. My firm does business in conjunction with them all.

A. W. Bennis, M.I.Mech.E.

Bolton, *January 16th*, 1906.

Zambesi Power Scheme.

In the article on the Zambesi Power Scheme, by Mr. W. B. Esson, which appeared in your last week's number, he writes that he joins issue with me on my statement that "if the capital charges and maintenance and renewals costs of the transmission line and the cost of energy lost in transmission involved by the use of water-power are much greater than the coal bill of a steam plant at the delivery end of the transmission line, then, obviously, the use of water-power cannot be justified."

In view of Mr. Esson's attitude to what I deem to be a proposition that should command universal acceptance, I am unable to argue the matter with him further, contenting myself by saying that, in his further investigations into the subject, I think Mr. Esson should not continue to ignore the fact stated by me that, since reading my paper in Johannesburg, I find that, by erecting at Vereeniging the power house for the supply of electricity to the Rand, coal can be obtained at 5s. per ton and an ample supply of water on extremely favourable terms. Under these conditions the coal and water bill of the projected works would be less than half the sum named by Mr. Esson.

Robert Hammond.

London, S.W., *January 16th*, 1906.

How to Screw Conduits.

We have read Mr. Schmahl's letter in your issue of January 3rd, and shall be glad if you will gives us space to set out our views on this important matter. Mr. Schmahl advocates the use of gas sizes both in diameter and thickness, and gas threads. Under no circumstances whatever can we agree to adopt them for our conduit system; for the following reasons:—

1. The thickness of gas tubes was settled originally for the convenience of welding. Now that better processes of manufacture have been invented, such as the seamless, such thicknesses become absolutely unnecessary.

2. The thread used by the principal conduit makers has been standardised, a proof of which assertion can be found in the fact that the screwing-machine makers now accept "Conduit Thread" to mean certain definite sizes and threads.

3. The thicknesses of tubes made by first-class firms are quite sufficient to take a full thread. We ourselves have never supplied conduit tube under the standard gauges given

in our catalogues and the catalogues of first-class companies, which gauges have been accepted by the whole of the electrical trade as standard. In extreme cases we have supplied one gauge thicker, but we have never altered the thread. We have always refused to compete with the so-called screwed light conduit accepted in inferior installations where everything is sacrified to price, and we entirely agree with Mr. Schmahl's remarks respecting this. We have actually seen conduit 19-gauge sold as screwed, though it has only been what we might call slightly scratched with the appearance of a thread. It is of course absolutely impossible to screw a full thread on such material, for the depth of the thread is more than the thickness of the tube. Such "screwed" tube is valueless.

4. As a standard has already been adopted by every firm of importance, there is no reason why we should fall out of line with it.

5. The electric trade itself would suffer by altering the standard, for with very few exceptions it has been adopted in all the large installations, and if any alteration were made there would be great confusion if at any time additions or alterations had to be made.

6. The standard conduit threads must not be classed as *fine* threads; on the contrary, in the two smaller sizes whose outside diameters are ½ in. and ⅝ in., the number of threads is 18, whereas for gas tubes corresponding to these sizes the standard thread is 19. For gas tubes whose outside diameters approximate to ¾ in., ⅞ in. and 1 in., the standard thread is 14 as against 16 in conduit tubes of similar sizes, but the latter standard is ample.

The company on whose behalf Mr. Schmahl writes is, we believe, with one exception, the only company which is endeavouring to push a standard of its own, and no doubt it would be pleased to have its views adopted, and thus scrap the whole of the material and stock held by its competitors.

The Perfecta Seamless Steel Tube and Conduit Co.
A. E. Hills, *Manager.*

Birmingham, *January 15th*, 1906.

In your last issue Mr. Schmahl, of the Armorduct Manufacturing Co., under the heading of "How to Screw Conduits," appeals for uniformity in gauges and threads for tubing used for electric wiring purposes, on the basis of "Gas Sizes, Screwed Standard Gas."

While there can be no question that standardisation is advisable, I cannot agree that gas standards should be adopted, nor with the reasons which Mr. Schmahl adduces in support of his arguments for their selection.

My own impression is that in the early days electric development was to an appreciable extent retarded by the too slavish copying of gas methods; the clumsy heavy electroliers manufactured after the pattern of the old gas chandeliers were an eyesore to everyone; but it was apparently taken for granted that what was necessary for the old illuminant was equally required in the new, despite the fact that the conditions were altogether different. The gas tube, with its rough and uneven surface was even taken as a standard conduit, until experience taught differently, and so on.

To deal with Mr. Schmahl's arguments in order. "So far as conduit tubes are concerned, my company has moved in the opposite direction to the majority of tube makers." Is this to imply that the whole of the conduit manufacturers have been developing on wrong lines, and the Armorduct alone, under the guiding hand of Mr. Schmahl, producing the ideal conduit? If we are to believe this startling announcement, very strong evidence is required to show that conduit manufacturers are gifted with such a small amount of foresight as he attributes to them.

Mr. Schmahl next endeavours to support his contention by telling us: "My company have supplied their standard Armorduct screwed conduit screwed gas size, and the material has been used for a large number of important installations." Here we have dished up the old trade puff, and probably every conduit manufacturer desirous of a free advertisement, could say the same thing about his conduits, screwed with Whitworth threads; if it were not so the presumption would be that they would not be doing business in screwed conduit.

The statement—"Needless to say I shall not only advocate standardisation on the basis of gas sizes and gas threads, but" . . . . "tubes of heavier gauge," is not altogether without bias. The Armorduct Co. sells tube with gas threads, and obviously for this reason, though ostensibly on the broader question of uniformity, Mr. Schmahl is willing to lend his support to standardisation provided gas threads are adopted.

Lastly—"I have made inquiries of a number of contractors, and in every case the opinion is—'gas sizes, gas threads.'" Once again, the free advertisement, the manufacturer telling the public that his (unbiased) inquiry tends to show that everyone demands what he manufactures! Our experience is entirely in the opposite direction, contractors and consultants being strongly in favour of the exclusive use of the Whitworth thread, which was first used by the company I represent, some seven years ago. This thread which has since been adopted by other conduit companies, and has become generally known as the Simplex thread, is in every way more suitable for conduit work. It was selected, in the first instance, because the standard gas thread was not suitable for the gauge of screwed conduit in most general use, and I am of opinion that a tube having a a wall exceeding No. 14 L.S.G. is an unnecessary expense, besides being unwieldy and unnecessary for electric work.

My company have not, with the single exception of the ½-in conduit, ever supplied a screwed tube under No. 16 L.S.G.; I do not, however, speak in the defence of a No. 19 gauge screwed tube mentioned by Mr. Schmahl in his letter, as this must be mechanically weak.

The so-called advantages of adopting gas standards for the electrical conduit trade are, in my opinion, illusory, for the following reasons:—

1. They necessitate the use of a special size conduit (gas size), which, with the exception of a few instances, do not conform to the standard conduit tube sizes used by the conduit trade in this country for electric wiring.

2. The fact so often urged that a contractor may have a set of gas stocks and dies is hardly worth consideration, as the initial cost is not heavy, and the state of the dies, due to the rough usage to which they are subjected in the gas trade, unfits them for use in conduit wiring.

3. The fact of using gas sizes gives rise to the very grave risk incurred, when, for the sake of convenience, cheapness, &c., rough cast-iron gas fittings are used in place of properly-designed malleable conduit fittings.

It seems to me that all Mr. Schmahl's statements present no argument in any way favourable to the adoption of gas sizes and threads.

I submit that unless very strong reason to the contrary is shown, it is permissible to assume that whatever sizes and gauges are in most general use at the time, are those which taken all round are the most advantageous for their purpose: and although I am quite prepared to take part in any meeting with the object of standardisation in the conduit business, I hardly think such a meeting will have much chance of achieving any useful purpose if others like Mr. Schmahl attend it with the avowed object of only supporting it on the basis which happens to be the most suitable for their own purposes.

The Simplex Steel Conduit Co.
L. M. Waterhouse,
Director and General Manager.

London, *January 16th*, 1906.

I have read Mr. Schmahl's letter in your current issue, but as I am unable to understand the idea of it, the following remarks may, perhaps, not be considered superfluous at this juncture.

If his desire is to advertise the fact that he is now using gas standard threads, I may be allowed to compliment him on following the example of my company and others, who have always employed them.

As I understand the case, however, the *proposed meeting* is to decide what standard shall be adopted, and the pros and cons to be considered do not concern the user or the consulting engineer. I, as well as others, have fully understood the idea of the trade for years, and you will find it clearly illustrated by the specifications of the leading con-

sulting engineers, which invariably call for standard gas threads.

If, however, it is thought advisable to settle this matter by public correspondence, the manufacturers who were present at the last meeting may consent to waive their rights of being considered in the matter; but as it is necessary that a uniform decision should be arrived at for any good purpose to be served, and seeing that Mr. Schmahl has already made up his mind on the point, I am forced to conclude that either our sympathy is due to those firms who now employ special threads, or, as is more probable, the discussion will result in a waste of time and of your valuable space.

C. E. Gunner.

London, *January 16th*, 1906.

REVIEWS.

Collected Researches of the National Physical Laboratory. Vol. I. To be had from the Director, National Physical Laboratory. Price 11s.

In the preface to this volume, Lord Rayleigh calls attention to the variety of the work carried out by the staff of the National Physical Laboratory. It contains the following papers, which certainly show variety :—

1. "An Analysis of the Results of the Kew Magnetographs on 'Quiet' Days during 11 years, 1890 to 1900, with a discussion of certain Phenomena in the Absolute Observations." By Charles Chree, Sc.D., LL.D., F.R.S., Superintendent of the Observatory Department.

2. "On the High Temperature Standards of the National Physical Laboratory. An Account of a Comparison of Platinum Thermometers and Thermo-junctions with the Gas Thermometer." By J. A. Harker, D.Sc., Fellow of Owens College, Manchester, Assistant in the Physics Department.

3. "On the Construction of some Mercury Standards of Resistance, with a determination of the Temperature Coefficient of Resistance of Mercury." By F. E. Smith, A.R.C.Sc., Assistant in the Physics Department.

4. "The Range of Solidification and the Critical Ranges of Iron-Carbon Alloys." By H. C. H. Carpenter, M.A., Ph.D., Assistant in the Physics Department, and B. F. E. Keeling, B.A., late Assistant in the Physics Department.

5. "On the Resistance of Plane Surfaces in a Uniform Current of Air." By T. E. Stanton, D.Sc., M.I.C.E., Superintendent of the Engineering Department.

In the second paper in this volume the author describes the investigations he has carried out in the laboratory in order to obtain a comparison between the gas thermometer and platinum thermometers and thermo-junctions. The work is a continuation of that carried out by the author and Dr. P. Chappuis. The apparatus and methods adopted are described, and the results are fully set out. The conclusion reached is that, up to a temperature of 1,000° C., Dr. Callendar's difference formula can be used.

In the third paper a subject more directly useful to the electrical profession is dealt with. As it was decided in the early days of the electrical industry to give up the apparent simplicity of an arbitrary choice of electrical units, and to base all measurements on the centimetre, gramme and second, the question of practical standards to meet the requirements of the industry has been of the utmost importance.

It may be recalled that the first absolute measurement of resistance in this country was made for the British Association in 1863, and from that time this association has instigated the research work necessary for the accurate rendering of the selected unit in practical form. As the knowledge and skill of the earlier scientists and mechanics improved, so greater accuracy was attained, and in 1892 a committee appointed by the Board of Trade made a series of recommendations which finally became law. This committee advised that the ohm should have a value of 1,000,000,000 in terms of the fundamental units, and that a column of mercury one square millimetre in section and 106·3 cm. long at the temperature of melting ice be taken as the standard. This unit is now defined in terms of length and weight.

The work carried out by the author at the National Physical Laboratory, and fully described in this paper, deals with the attempts of the staff at Bushey House to realise this unit, and is a continuation of the work carried out in the past for the British Association.

Commencing with the theory of construction, the author explains in detail the methods adopted for measuring the length and testing the cross-section at different parts of the tube. These methods are also described in "Practical Physics," by Glazebrook and Shaw. From the results of these measurements the correcting factors were calculated. Eleven only out of about 70 tubes were found with a sufficiently true bore to be suitable. After carefully preparing and cutting to the required length the tubes were carefully cleaned, mounted and filled with mercury, and the resistances compared with the existing standards at the Laboratory.

The methods adopted for measuring the resistance are explained, and the results obtained are tabulated. The results indicate that under favourable conditions, and with the assistance of elaborate apparatus and highly skilled labour, it is possible to construct mercury standards of resistance which have resistances much more nearly alike than determinations of the absolute value of the ohm are likely to be.

The work carried out and described by Mr. F. E. Smith gives an excellent idea of the work the National Physical Laboratory can accomplish. It also represents another step towards the realisation of a satisfactory standard of resistance.

All the papers printed in this volume have been published in other works. It would be more satisfactory if the authorities at the laboratory were to publish each paper separately, as the range of subjects in this volume is greater than most people will require; or, in the case of shorter papers, to arrange them under subjects and publish them in that form.

National Engineering and Trade Lectures. Vol. II.—British Progress in Pumps and Pumping Engines. By P. R. BJORLING. London: Constable & Co. 1905. 6s. net.

This book is Vol. II. of this somewhat novel series of books, the object of which is twofold, the first being to place on record the modern developments and examples of the particular subject dealt with in each volume, and the second to furnish a directory of names of British firms engaged in the manufacture of the special things dealt with in the book.

Pumps are important engineering constructions, yet how few engineers really know much about them. The ordinary rules for pump discharge may religiously allow a certain discount from the theoretical discharge for that vague idea known as slip. There probably is slip with some pumps, especially if their valves lift too high, and are not rapid in closing. But many pumps have no slip at all; they deliver a larger quantity of water than is measured by the volume generated by the pump bucket, and the very simple explanation is that in a long suction pipe, a column of water travelling at a considerable velocity tends to maintain that velocity, and will flow through the foot valve and through the descending bucket in considerable quantity, especially if there is a low head above the bucket. This can be noted with a hand pump by suddenly stopping the bucket, and watching the water continuing to flow upwards, impelled by the stored energy in the upward-moving column in the suction pipe.

Among the novelties named in the book before us is the compressed-air pump. It is rather a disappointment to find that only two pages, of little value, are given to this latest method of pumping. It is well known that the air-lift pump requires at least three times as much power as an ordinary pump for the same output. We should like to have something said about this, about the proper diameter for a given output, the proper submersion, and so on. We should like to see some practical advice about the maximum diameter of rising main where the water in an artesian well comes from horizons above the foot-piece of the rising main; but we find nothing on these points. Perhaps it is too much to expect to see a description of the recently devised variable-

stroke pump for electrical driving. In this new device the pumps are driven by a pair of superposed eccentrics, so arranged that their eccentricities may be opposed or together; thus the pump stroke may be *nil* or a maximum, and the pump can be started with no stroke against a heavy head, and the eccentrics gradually brought up to full stroke.

For many years the direct-acting steam pump of American manufacture was largely bought, but the more economical and solidly constructed pump of Weir and others has pushed out the cheap American pump, the value of which was even less than its price.

Among other pumps illustrated is the "Dando" diaphragm pump, which has no bucket, but consists mainly of a chamber, the volume of which is varied by means of a slack diaphragm to which the pump handle is attached to raise or depress it so as to vary the volume of the chamber. Such pumps will pump water containing grit.

Not much is said on the subject of bore-hole pumps. One by Messrs. Mather & Platt is illustrated with apparently metal valves. The simple deep-well pump, with solid-grooved ringless, and therefore frictionless, bucket and Dermatine valves, as arranged by Mr. W. H. Booth, is not referred to, yet these simple pumps have been put to work in wells from 2½ in. diameter and upwards all over England.

In Ireland, where cheap pumps are needed, we have seen excellent work done in wood with thin brass lining tube in the wooden barrel, the whole work of the village carpenter's style, but good and efficient.

We note that the Ashley bore-hole pump is illustrated, also the Haste pump and some series pumps of the centrifugal type. A good deal in the book is hardly new, but it would be difficult to fill a book with strictly modern developments, and much fault cannot be found with the author's selection, containing, among other things already noted, several pumps by Messrs. Hathorn, Davy & Co., Gwynne & Co., P. R. Jackson & Co., G. & J. Weir, and others.

LEGAL.

British Pioneer Electric Light and Power Co. of India, Ltd.

The Master of the Rolls and Lords Justices Romer and Cozens-Hardy on Thursday last week heard an appeal by Messrs. S. T. Biggs and C. R. Sawyer against the dismissal by Mr. Justice Joyce of a petition for the compulsory winding up of the above company. The company was in course of voluntary liquidation by resolution passed after the presentation of the petition but before its hearing.

Mr. Gore Brown, K.C., for the appellants, said the ground of the application was substantially that there were misfeasances on the part of the directors which ought to be investigated by an independent liquidator, and not by the secretary of the company who had been appointed liquidator in the voluntary liquidation, and who had been a servant of the directors whose conduct had been impugned. The petitioners were mortgagees for a certain Mrs. Bingham, and of the 300 shares of which they were the registered holders 200 had been given to Mr. Bingham for certain services, and the others he had taken up in the ordinary way. The company was incorporated in 1899 with a capital of £3,000 in £1 shares. The company had acquired a concession for the construction of an electric tramway in Bombay, and subsequent dealings with it had produced a sum of £20,000, and resulted in the return to the shareholders of £6 15s. per share, or nine times the amount subscribed, only 15s. per share having been paid up, except in the case of those held by the petitioners. For the first two years there were three directors, viz., Mr. Thomas Anderson Kelman and his sons, Stuart and Erskine Kelman. In 1900 the Rowell Stuart Kelman Co., Ltd., was formed, the directors being the two younger Kelmans and a Mr. Mackintosh. There were dealings between these two companies, the Pioneer Co. giving considerable benefit to the Kelman Co. in respect of the concession. It was suggested that they had been of great service in securing the concession, but the petitioners' case, supported by the evidence of Mr. Bingham, was that that gentleman had obtained the concession, and had had no assistance at all from the Kelman Co. The net result of the transactions between the two companies was that at least £11,500 had been lost to the Pioneer Co.

Without calling on the other side the Master of the Rolls, in giving judgment, said the Kelman Co. had, or thought they had, some special opportunities which enabled them to put the Pioneer Co. in a position to obtain a valuable concession. The concession was obtained, and certain shares in the advantages arising from it were given to the Kelman Co. The complication in the case arose from the fact that the two companies had directors in common, but he agreed with Mr. Justice Buckley that the correspondence indicated *bond-fide* discussion and negotiation between persons dealing at arm's length. There was no *primâ facie* evidence of fraud or misfeasance on the part of the directors, and he was not satisfied that there was any reason to suppose that any reasonable advantage would be obtained by the applicants by resorting to compulsory winding-up. The onus was on them of showing that complete justice would not be done under voluntary winding up, but there was no reasonable ground for supposing that they would be deprived of any right to which they were entitled. The decision of the Court below was absolutely right, and the appeal must be dismissed with costs.

Lords Justices Romer and Cozens-Hardy concurred, and the appeal was dismissed accordingly.

C. S. Davidson *v.* The Sun Fan Co., Ltd.

In the Chancery Division of the High Court of Justice on Thursday last week, Mr. Justice Farwell had before him this case, which was brought by C. S. Davidson, Belfast, against the Sun Fan Co., Ltd. of Bradford.

Mr. Bousfield, K.C., for the plaintiff, said this was a motion to commit the defendants or to sequestrate the defendant company for breach of an injunction restraining them from infringing plaintiff's patent, No. 4,609, of 1898, for ventilating fans. Defendants had consented to the injunction, but since the date of their consent they had put forward an apparatus slightly different from that which was the subject of the injunction. The injunction was that the defendants should not manufacture an apparatus similar to or differing only colourably from that described in plaintiff's specification. Defendants did not stand in terror of being sent to prison so far as plaintiff's motion was concerned. This was the only manner in which they could get the opinion of the Court on the matter. The question simply was whether that which defendant was now actually making was substantially the same thing as that which, by consent, he was enjoined not to make or sell. One of the most important features of plaintiff's invention was the use of an eye which was substantially of the same diameter as the exterior of the revolving blades, so that one got the full area of the circle made by the revolving fan for the drawing in of the air. The blades were made as narrow as possible in proportion to the total diameter. That had proved to be an enormous advance in the art of fan making for blowing and ventilating. The Law Courts were ventilated by means of the Davidson fan, and one advantage it possessed was that it required only a fraction of the space which was necessary before this invention. The point upon which defendant was relying was that he was making the blades of his fan rather wider than he did before, and that his fan was now outside the limits of plaintiff's specification.

On Friday Mr. Dugald Clerk, the well-known patent expert, who was called on behalf of the plaintiff, admitted in cross-examination that the effect of a slight alteration of the angle at which the blades of the fan were set, or a slight increase in the width of the blades, might be very great.

A discussion arose between counsel as to the necessity for the plaintiff's advisers making experiments with the defendant company's apparatus, and in the result it was agreed that the further hearing of the action should be postponed until those experiments had been made.

Mayor and Corporation of Norwich *v.* The Norwich Electric Tramway Co.

In the Court of Appeal on Thursday last week, before Lords Justices Vaughan-Williams and Stirling, counsel stated that this case, after having been partly heard by the Court, was ordered to stand over until the decision of the House of Lords, in the case of Crossfield *v.* The Manchester Ship Canal, had been obtained. That case was now decided, and parties were now anxious that the Norwich case should be restored to the list.

The Court directed that the case should be placed in the Jural list.

Lamont *v.* Lanarkshire Tramways Co.

Before Lord Salvesen and a jury in the Court of Session last week, Hector M'Kenzie Lamont, of Wishaw, sued the Lanarkshire Tramway Co., claiming £750 as damages for personal injuries. On June 7th last, he was travelling on the top of an electric car from Wishaw to Motherwell, and as the car was passing beneath the bridge at the Lanarkshire Steel Works the trolley pole left the wires, swung round, and struck the pursuer violently on the head, and severely injured him. The accident, pursuer alleged, was due to reckless driving. The defenders denied fault, and stated that the car was driven at a proper rate of speed, that pursuer's injuries were the result of pure misadventure, and that they were greatly exaggerated. The jury returned with a unanimous verdict for the pursuer, and assessed the damage at £500.

Corporation of Swansea *v.* National Telephone Co.

This case was mentioned in the Appeal Court this Tuesday morning.

Lord Justice Stirling said they proposed to refer certain questions for inquiry and report to a referee. They had made inquiry as to the person to whom such a matter might be referred, and were of opinion that Major Cardew, late of the Royal Engineers, who was a well-known gentleman, would be a proper person to whom the matter might be referred. They therefore proposed to make an order, of which the following was an outline:—"Order

that the following questions arising in this case be referred to Major Cardew for inquiry and report: First, whether the laying down of sufficient junction wires between the several exchanges of the Corporation and the company respectively at Swansea, Mumbles and Morristown, will afford all proper facilities for the transmission of telephonic messages between persons using the system of the company and persons using the system of the Corporation? Secondly, if not, whether in order to afford all proper facilities for the transmission of telephonic messages between persons using the systems of the company and persons using the system of the Corporation, it is necessary that the company should provide junctions, circuits, and directly connect its principal exchanges in Swansea and nine other places mentioned or any and each of such places. Thirdly, whether any and what additional steps ought to be taken by the Corporation and the company respectively in order to afford all proper facilities for the transmission of telephonic messages between persons using the system of the company and persons using the system of the corporation."

Mr. Danckwerts thought this did not make provision for what the appellants considered the very crux of the matter, namely, that wherever exchanges were connected the connection should be by means of double wires—one for all messages from the company's station to the Corporation's station and a *per contra* wire for messages in the opposite direction.

Lord Justice Stirling thought that was clearly provided for in the second clause.

Mr. Danckwerts: I do not think that meets my point. My proposition applies equally as much to the first proposition as to the second.

Lord Justice Stirling: I will hand this down. If you have any remarks to make upon it, we might perhaps alter them.

Mr. R. J. Parker: I think that the best plan would be for both sides to have a copy of that, and then we can consider it; and if your Lordships would give us a little time, that we might mention the matter later.

Mr. Danckwerts: I think Mr. Parker and myself might agree about this.

Mr. Parker: I am not so sure about that.

Mr. Danckwerts: Might I be permitted to ask a question? Your Lordship said: "Refer to inquiry and report." That is not under the Arbitration Act.

Lord Justice Stirling: Yes, it is meant to be.

Mr. Danckwerts: I rather understood from what was said on a previous occasion it was not intended to be under the Arbitration Act, but was intended to be under the general jurisdiction of the Court, so as to be in the same position as a report by a master. I understood that neither side wished the report to conclude the matter.

Lord Justice Stirling: No. It is understood not to preclude the jurisdiction of the Court; but I do not take the view of the Arbitration Act that you suggest. I thought it was provided that where the matter was simply referred to inquiry and report it was open to the Court to adopt or not.

Mr. Danckwerts: No, I do not think so.

Lord Justice Stirling: We are all agreed that the Court is not to be bound by it, nor are the parties.

In the result, Lord Justice Vaughan-Williams said the better plan would be for Mr. Parker and Mr. Danckwerts to exchange their views on the matter and mention it to the Court on Monday morning next.

Greaves *v.* Stalybridge, Hyde, Mossley & Dukinfield Tramways and Electricity Board.

In this case, heard at Stalybridge County Court on January 11th, before Judge Reginald Brown, K.C., the plaintiff claimed £30 damages for injuries sustained whilst travelling in an electric car on June 10th, 1905, and the board pleaded the statutory defence under the Public Authorities' Protection Act, 1893 (Section 1), that proceedings had not been commenced within six months of the date of the accident. On the other hand, counsel for the plaintiff submitted that the Board was not entitled to the benefit of the provisions of that statute. It was also pointed out that as December 10th, 1905, fell on a Sunday, the plaintiff was entitled to commence his proceedings on the following day.

The Judge pointed out that *primâ facie* the plaintiff was one day over the six months' limit in commencing his proceedings, and the fact that the last day of the six months fell on a Sunday did not give the plaintiff an extra day in which to commence his action. He therefore gave judgment for the Board.

Electrical Ore Finding Co.

The affairs of this company were mentioned before Mr. Justice Warrington, taking winding-up business on Tuesday. A petition had been filed by a shareholder and creditor. The company had now, however, passed a voluntary winding-up order, and the petitioner accordingly asked leave to withdraw the petition.

Electric Launch for Cardiff.—The Corporation of Cardiff is ordering an electric motor-launch for use on the Roath Park lake.

ELECTRICAL COMPETITION IN THE MARKETS OF THE WORLD.

A Teutonic Comparison of German-American Rivalry.

An interesting and detailed comparison of the results attending the competition which the American (United States) electrical engineering firms as a whole bring to bear in relation to their German rivals has just been made by Dr. Glier in the issue of the *Elektrotechnische Zeitschrift*, of January 4th, 1906. The comparison is interesting from the fact that Great Britain is both directly and indirectly concerned with the question, although the details given in the article are so abundant that it is only possible to make a summary of the nine columns of matter contained in the original.

It is pointed out that according to the United States census returns, the works engaged in the production of "electrical apparatus and supplies" numbered 76 in 1880, and employed 1,271 workers; in 1890 there were 189 works, and 8,802 employés, and in 1900 the figures were 580 and 40,890 respectively. In addition to these the concerns occupied with "electrical construction and repairs" comprised 1,162 in 1900, and employed 5,949 workers, thus making a grand total of 46,839 employés in that year. It is calculated that the total value of the products of the electrical industry amounted to £21,500,000 in 1900, but as the inland demand is unable to absorb the large output, the American firms have been compelled to enter the markets of the world, and this has been done with considerable success down to the present time. The author gives figures showing that the exports of electrical machinery and appliances from the United States, which reached a value of £964,000 in 1897-8 (the fiscal year ends on June 30th), advanced to £2,155,000 in 1899-1900, and to £2,450,000 in 1904-5. On the other hand, there were probably slight imports of electrical machinery, but these, with the exception of arc light carbons, are not specially separated in the official statistics. In the case of Germany, the value of the exports of electrical machinery, accumulators, telegraph and telephone apparatus and cables and conductors averaged £2,200,000 in the three years 1901, 1902 and 1903, the complete figures for 1904 not being cited.

The principal district which the Americans formerly contested the most in rivalry with the Germans was Europe. Of the total exports from the United States, the electrical machinery shipped to Europe represented 52 per cent. of the value in 1897-8, 49 per cent. in 1899-1900, 44 per cent. in 1902-3, 27 per cent. in 1903-4, and 23 per cent. in 1904-5. The value of electrical apparatus exported to Europe was 43 per cent. of the total exports in 1897-8, 50 per cent. in 1899-1900, 34 per cent. in 1902-3, and 45 per cent. in 1903-4. The decline in the American exports of machinery to Europe has therefore been considerable, although it is estimated that fully 20 per cent. of the exports still reach the Old World. As the main market of rivalry between the United States and Germany has hitherto been England, the following table of the values of the electrical machinery—not including apparatus—sent to the United Kingdom by both countries should be instructive for the period of years quoted:—

Year.	German electrical machinery exported to the United Kingdom.	Percentage value of total German exports.
1900	£86,250	= 8 per cent.
1901	120,950	= 12 „
1902	373,350	= 30 „
1903	289,550	= 27 „
1904	210,700	= 20 „

Year.	United States electrical machinery exported to the United Kingdom.	Percentage value of total United States exports.
1899-1900	£313,800	= 36 per cent.
1900-1901	552,000	= 48 „
1901-1902	514,600	= 48 „
1902-1903	451,200	= 39 „
1903-1904	264,600	= 23 „
1904-1905	217,800	= 15 „

The considerable advance in the value of the exports from the United States in the earlier years mentioned is said to be connected with the association of the late Mr. Yerkes with the construction of underground railways in London; and the author admits that the Americans have badly beaten the Germans in the English market. Next in importance to the latter from the German standpoint are the markets of Belgium, Russia and Italy. These three countries combined absorbed 43 per cent. (£496,250) of the total German exports in 1900, 40 per cent. in 1901, 26 per cent. each in 1902 and 1903 and 29 per cent. (£313,400) in 1904. On the other hand, the American exports of electrical machinery to the three countries in question, which reached £47,600 in 1897-8, gradually declined to £20,800 in 1902-3, but recovered to £30,800 in 1903-4. The author, in commenting upon his detailed figures, states that while the Germans continue to make progress in Belgium, the Americans scarcely come into competition with them in that country, and that although the Teutonic exports to Italy and Russia are declining, this is not due to American rivalry, but rather to a lessened demand in conjunction with a growth of the native industries. Except in the case of France, American competition is insignificant or non-existent in other European countries as, for instance, Spain, Holland, Sweden, Norway, Austria-Hungary and Switzerland. The value of the exports of United States machinery to Germany was £25,750 in 1900, as compared with only £5,900 in 1904.

The question of competition outside of Europe is then dealt with by Dr. Glier. Taking first of all the cases of British North America, Mexico and Japan, it is shown that these countries purchased electrical machinery to the extent of £80,000 from the United States in 1897-8, £555,200 in 1903-4, and £805,600 in 1904-5, or 20 per cent., 49 per cent., and 55 per cent. respectively of the total exports of electrical machinery. The exports of electrical appliances from America to the three countries have also largely increased in the same period of years. In contradistinction to this position of affairs, the German exports to the same countries have been inconsiderable, and the author submits, therefore, that the Americans dominate the trade of Canada, Mexico and Japan, and that the Germans are not making progress in those countries.

The markets of South America also bring the two manufacturing nations into strong trade rivalry. By means of statistics it is demonstrated that in general the exports of machinery from Germany to Argentina and Brazil in the past five years have increased, but no signs of development are noticeable in regard to Chile, Uruguay and Peru. As against the German trade, the exports of the United States are shown to be increasing. Among other countries, it is mentioned that the Germans have beaten the Americans in the Australian market and that neither Algeria nor British East Africa comes into consideration for either of the two rivals, but that the keen contest in British South Africa seems to be tending in favour of the United States.

The question of electrical apparatus is treated separately from that of machinery. It is shown that the American exports amounted to £841,400 in 1902-3, £992,000 in 1903-4, and £992,600 in 1904-5, and that the principal quantity is forwarded to Europe, England in particular buying very largely. Dr. Glier recalls the fact that the imports of electrical machinery into the United States are not specifically enumerated, and that presumably they are very small. The figures which he gives for Germany are trivial, except in the case of arc lamp carbons, the value of which averaged £14,600 in the five years ended with 1904. In conclusion, he briefly summarises the conclusions which have already been set forth in relation to the results of the industrial competition between the two exporting countries as represented by the United States and Germany.

BUSINESS NOTES.

Worthington Contracts.—The following contracts have recently been secured by the WORTHINGTON PUMP CO., LTD.:—

Two complete condensing sets for the St. Ouie Railway, Paris, each condenser having 20,000 sq. ft. of cooling surface and pumps.
6,000 sq. ft. condenser and pumps for the Robinson Deep Mining Co.
Two complete sets for the Consolidated Goldfields of South Africa, each condenser having 2,500 sq. ft. of cooling surface, with pumps.
For the Aston Manor Electric Light Station, one condenser with 2,000 sq. ft. of cooling surface on combined pumps.
For the Cossipore Shell Factory, condenser with 1,860 sq. ft. of cooling surface.
Two sets for the Rio Janeiro Docks, 1,200 sq. ft. condensers, complete with pumps.
One 1,000 sq. ft. condenser for Messrs. Lever, Bros., Ltd.
And a number of other condensers ranging from 300 sq. ft. to 1,000 sq. in.
In addition to the above a number of jet condensing plants have been ordered.

Crompton's Christmas Party.—Owing to the munificence of MESSRS. CROMPTON & CO., LTD., Chelmsford, the Arc Works Club was enabled to entertain the wives and children of its members to a tea, Christmas trees, and variety entertainment, in the Corn Exchange, Chelmsford, on Saturday, 6th inst. There were present upwards of 900, mothers, children and guests, the latter including Mrs. and Colonel Crompton; Sir Carne Rasch, Bart., M.P.; Lady Capel; the general manager, Mr. Hew Stevenson, Mrs. Stevenson; the works manager, Mr. A. J. Hodgson and Mrs. Hodgson; Mr. Francis R. Reeves, Miss Reeves; Mrs. and Mr. Claud Crompton; the Mayor and Mayoress of Chelmsford; and the majority of the clergy of the town. Tea was followed by a Punch and Judy show and conjuring entertainment, and a fairy tale play entitled the "Goose Girl," was much enjoyed. A baby show was held in which Mrs. Crompton, Lady Capel, and the Mayoress, found much difficulty in awarding the prizes. The eight large Christmas trees, which were heavily laden with toys, were next visited and soon stripped of their beauty, each child receiving two presents. After brief speeches by the Mayor and Colonel Crompton, the National Anthem was sung, bringing a very enjoyable time to a close. Mr. P. G. Cheverton is the newly appointed hon. secretary to the club.

Horsfall Destructor at Swansea.—This plant consists of five Horsfall standard back-feed cells having 42 sq. ft. grate area in each cell, and provided with the Horsfall patent hot blast arrangements with steam jets, patent front exhaust flues, special feeding and clinkering doors, and the other usual features of this style of plant. The destructor is provided with a Lancashire boiler 30 ft. × 8 ft. 6 in., having a working pressure of 180 lb. per sq. in., and the chimney is 120 ft. in height. Annexed to the destructor are a set of clinker crushing and screening machines, mortar mill, and engine for driving same. The destructor cells, flues, boiler, chimney, destructor building and machinery were all erected by the Horsfall Destructor Co., Ltd., for the Corporation of Swansea, under the supervision of Mr. George Bell, the borough surveyor. Connected with the destructor is an electricity substation under the control of the borough electrical engineer, and containing one 225-KW. British Schuckert dynamo, coupled direct to a marine triple-expansion open-type engine by Messrs. J. and H. MacLaren, of Leeds, running at a speed of 150 r.p.m., and capable of developing 450 I.H.P. This machinery operates 4½ miles (route length) of electric tramway. The steam is provided from the destructor boiler, and there is no other boiler on the works. The destructor boiler is, however, provided with a furnace in which a small quantity of coal can be burned if required. The official trial of the plant, to ascertain whether its burning and steam-raising capacities were up to guarantee, was successfully carried out on January 12th and 13th, 1905, the results obtained being as follows:—

Duration of test	23 hours.
Total quantity of refuse burned	70 tons 16 cwts.
" " per cell per 24 hours	14 tons 15 cwts.
" " per man per shift	7 tons 17 cwts.
Rate of wages	6s. 6d. per shift of eight hours.
Cost of labour per ton	8·4d.
Total water evaporated	15,500 gallons.
" " per lb. of refuse from and at 212° F.	1·20 lb.
Steam pressure maintained	176 lb.
Horse-power developed at 20 lb. steam per I.H.P.-hour	336

At the time of this trial the electrical machinery had not been installed. It has since been completed, and although there has not been a complete electrical test, the following figures are furnished to us to show roughly the results obtained:—The average quantity of refuse dealt with during the month of November, 1905, amounted to 60 tons 9 cwts. per day, and on Tuesday, November 21st, the engine ran from 8 a.m. to 10.45 p.m. (= 14¾ hours), and produced 1,285 electrical units, no coal being burned. This gives an average result of about 32 units per ton. On Saturday, November 25th, when the load on the tramways was the heaviest in the week, the engine ran from 8 a.m. to 11 p.m. (= 15 hours), 1,958 electrical units were generated, and 8 cwt. of coal was burned in the coal firing furnace. Assuming 1 lb. of coal to be the equivalent of 8 lb. of refuse, this equals an output of about 45 units per ton of refuse. It will be claimed, therefore, that the destructor is fully capable of operating this length of tramway without assistance except at the times of heaviest load on Saturdays, when a very small quantity of coal has to be occasionally burnt, not to assist the destructor, but to meet the peak of the electricity load. It must also be mentioned that besides the electrical output, the steam raised from refuse supplies the forced draught to the destructor, and the power for the clinker crushing machine and mortar mill engine, so that there is a considerable amount of steam generated in addition to what the electricity station uses. The Swansea destructor is, therefore, doing better work than was claimed for it, either by the promoters of the scheme, or by the contractors, before its erection.

Machine Stoking.—The lecture delivered by Mr. A. W. Bennis recently before the Keighley Association of Engineers on "Is Machine Stoking Economical?" which was reprinted by MESSRS. E. BENNIS & CO., LTD., has run through five editions. Applications for copies should be made to the firm at their head office at Bolton.

Messrs. Graham, Morton & Co.: A New Start.—A few weeks ago we announced that the firm of GRAHAM, MORTON, LTD., which displayed a remarkable spirit of enterprise and seemed by reason of its energy and up-to-dateness to be carrying everything before it a short time ago, had gone into voluntary liquidation. This decision was arrived at on December 27th, 1905. Our readers will be interested to learn that Mr. Maurice Graham, the founder and managing director of that firm, has decided to commence in the same line of business for himself, as a private concern, under the title of "Graham, Morton & Co.," at Pepper Road, Hunslet, Leeds. The liquidation of the company we understand to be accounted for largely by the great engineering law case against the Compagnie L'Union des Gaz, Milan, whereby the plaintiffs (Graham, Morton & Co., Ltd.) sued for the sum of £5,483, and the defendants counterclaimed for the sum of £70,000. This case was referred to in the ELECTRICAL REVIEW at the time of trial. The plaintiffs obtained the verdict, given by Mr. Justice Grantham, who spoke in terms of high praise of their work. We understand, however, that this lawsuit caused the complete disorganisation of the business of Graham, Morton & Co., Ltd., and indirectly cost over £30,000. Mr. Graham is stated to have personally lost over £36,000 in fighting for his own reputation and that of his firm. Those who remember the excellent record established by the old company in so short a time will wish Mr. Maurice Graham unhampered success in his new endeavours. The firm will specialise in elevating and conveying machinery, furnace building, colliery plant, steel bunkers, aerial ropeways, &c.

The Crystal Palace Automobile Show.—The fifth show at the Crystal Palace is to be held from the 26th inst. to February 3rd inclusive. Mr. Frederic W. Baily is secretary and manager for the fifth year in succession. There will be trial runs in the grounds, also an interesting motor-boat section, in which the Thames Electric and Motor-Boats, Ltd., will exhibit. The general list of exhibitors includes the name of the Krieger Electric Carriage Co.

Consular Notes.—SHANGHAI.—The Austro-Hungarian Consul at Shanghai in a recent report states that the imports of electro-technical materials in 1904 amounted to 1,250,000 fr., as compared with 1,300,000 fr. in 1903. The Consul deplores the fact that his countrymen do not take the share of the trade which they might take, owing to the fact that they have not their own agents, without whom business cannot be done. The importation is chiefly from Great Britain. The Consul anticipates that with the forward steps which China is making, there will, in the near future, be a good opening for these goods.

Private Bills in Parliament.—The following, amongst other petitions, have been deposited in the Private Bill Office of the House of Commons, alleging non-compliance with Standing Orders:—

London County Council Tramways.—From the Willesden Urban District Council, alleging that the promoters had not obtained their consent as the local authority to the construction of tramways in Shoot Up Road, Cricklewood Broadway, Edgware Road and the High Road, Kilburn. The County Council of Middlesex have lodged a petition on the same grounds. The Metropolitan Borough of Shoreditch complain that the County Council have not carried out the Standing Orders, inasmuch as they have not obtained their consent to Tramway No. 5, which is a line proposed to be laid through their area.

Folkestone, Sandgate and Hythe Tramways (No. 1 Bill).—Four petitions are lodged against this Bill by the Sandgate Urban District Council, Fredk. Rendell and others, E. R. Alston and others, and L. B. Schlesinger and others. It is alleged that the consent of the Sandgate U.D.C. has not been obtained, and that the statutory money deposit has not been lodged with the Paymaster-General. The other petitioners allege defective notices in regard to various points.

Folkestone, Sandgate and Hythe Tramways (No. 2 Bill).—The Sandgate and Hythe Electric Co. and Alfred Drake Brockman are petitioning against this Bill. It is alleged by the company that the notices do not describe all the termini of the proposed works, and do not state the objects of the application, and that the plans are defective in a number of particulars. The other petition was one by frontagers, and it is alleged that defective descriptions of property are given.

Cork City Railway and Works.—Mr. T. Donovan and others allege that the proposed works under this Bill are tramways, and not railways, and that accordingly the Standing Orders as to tramways are applicable to such works, and have not been complied with.

London United Tramways.—The Middlesex County Council and the Richmond Corporation have lodged petitions against this Bill. The County Council allege that their consent as the road authority has not been obtained to the proposed tramway near Kew Bridge, and the Richmond Corporation make a similar allegation in regard to proposed tramways in their district.

West Yorkshire Tramways.—In this case Brighouse Corporation allege that the consent of the road authority having jurisdiction over two-thirds of the proposed tramway has not been obtained.

Middlesex County Council Tramways.—The Willesden U.D.C. complain that the County Council have not obtained their consent, as the road authority, to the laying of a tramway in the Edgware Road, and the London County Council make a similar allegation with regard to a portion of the Edgware Road tramway.

Cork Link Railways.—The Cork Harbour Commissioners allege that the notices do not contain the true objects of the Bill in regard to the clause to allow the company and the Cork Electric Tramways and Lighting Co. or any railway or tramway company to agree as to the supply of electric energy, &c., and also that the books of reference do not correctly describe properties proposed to be taken.

On Tuesday the following memorials alleging non-compliance with Standing Orders were deposited:—To the Derbyshire and Nottingshire Tramway Bill, by the Basford Rural District Council, the Notts County Council and the Derbyshire County Council; to the Derbyshire and Nottinghamshire Electric Power Bill, by the Sheffield Corporation, the Basford R.D.C. and the Notts and Derby County Councils; to the London and Brighton Motor Way, by Lord Hilton, R. Trower and others.

Scotch Tramway Provisional Orders.—The following petitions on merits have been deposited in the Scottish Office in opposition to the under-mentioned Provisional Orders:—To the Falkirk and District Tramways, by eight petitioners, including the Scottish Central Electric Power Co., the North British and Caledonian Railway Companies and the National Telephone Co.; to the Ardrossan, Saltcoats and District Tramways, by 18 petitioners, including the National Telephone Co., the Ayr County Council and the Town Councils of Saltcoats and Ardrossan; to the Dumbartonshire Tramways, by 11 petitioners, including the Dumbarton Town Council, the Clyde Valley Electric Power Co., North British Railway and Glasgow Corporation; to the Dunfermline and District Tramways, by six petitioners, including the Fife County Council, the Fife Electric Power Co., the National Telephone Co. and the North British Railway.

Bankruptcy Proceedings.—A. G. NEW.—Under the failure of Anthony George New, electrical engineer, &c., of Palace Chambers, Westminster, and elsewhere, the bankrupt applied on January 12th to Mr. Registrar Brougham, at the London Bankruptcy Court, for an order of discharge. Mr. G. W. Chapman, Official Receiver, reported that the failure occurred in July, 1905; the ranking liabilities amounted to £13,216 18s. 2d., and the assets, valued at £38 15s., had not realised anything. The bankrupt commenced business in June, 1892, as an electrical engineer, in partnership with another person, at Palace Chambers, Westminster, and at Woking. They subsequently opened branches at Kingston-on-Thames, Hull and Rottingdean. In September, 1895, the business was formed into a limited company with a capital of £150,000, and the bankrupt was appointed to the post of managing director at a salary of £500 a year. The company, however, was not successful, and was wound up in 1897. During the following year the liquidator formed another company with a nominal capital of £3,750, to take over the assets of the old company, the bankrupt retaining the post of director at a salary of £100 a year. This company was also unsuccessful, and ceased to do business in 1901. In 1900 the bankrupt obtained an appointment on the staff of a publishing company, which position he held at the date of the receiving order. His failure and insolvency were entirely due to guarantees entered into by him on behalf of the partnership and the first company. He had no means with which to meet those guarantees other than his interest in the business, nor had he any prospect of discharging the liabilities so incurred in the event—which happened—of the failure of the principal debtors. The offences reported by the Official Receiver were (1) insufficiency of assets to pay 10s. in the £ to the creditors, and (2) incurring debts provable in bankruptcy without having at the time any probable ground of expectation of being able to pay them. His Honour upheld the report, and suspended the discharge for three years from the conclusion of the public examination in September, 1905. Order entered accordingly.

An order was made on January 9th at Wandsworth against W. LESLIE, electrical engineer, Putney, and of Brixton Prison.

January 27th is the last day for receiving proofs for intended dividend in *re* C. V. T. DE FALBE, electrical engineer, Penywern Road, Earl's Court. Trustee: E. H. Hawkins, 3, Barbican, E.C.

JONES & CATHRALL, electrical engineers, Chester Street, Wrexham.—The adjourned public examination took place on January 9th. At the previous examination, debtors were ordered to file a cash account for the last year's trading, and an account between the landlord and themselves for the past four years. These, it was reported, had not been filed, and the examination was again adjourned for them to be furnished to the Official Receiver.

JAMES WOOD SMITH.—At Blackburn Bankruptcy Court on January 10th, J. W. Smith, electrical engineer and contractor, trading as Smith & Co., at 55, Bolton Road, Darwen, was examined. The accounts showed liabilities amounting to £128 17s., and assets estimated to realise £30. Debtor attributed his failure to bad trade, ill-health, and shortness of capital. He began business in January, 1905, with a borrowed capital of £12, which had been repaid. Previously he was a wireman earning, when well enough to work, £1 7s. 6d. per week. He admitted that he discovered his insolvency five months ago, but he continued to trade in the hope that his business would improve. The turnover from the business he estimated at £2 10s. per week on the average, and there was no profit. All the debts were for goods supplied in and since March last. The examination was adjourned.

JAMES BROCKIE, mechanical engineer, 41, London Road, Forest Hill, Kent.—Receiving order made at Greenwich Court on January 11th on debtor's own petition.

Fire Alarms.—The Fire Offices Committee of the Tariff Insurance Companies of the United Kingdom have now resolved to recognise approved automatic alarms, including the May-Oatway and the Pearson systems, and rebates on fire insurance premiums will be allowed for property protected by them.

Catalogues and Lists.—MESSRS. TURNER & HUDSON, Ivy Street, Hoxton, N.—Revised price list of white wood electric wire casing and cover.

MESSRS. ESCHER WYSS & Co., Zurich.—A large sheet of illustrations of the firm's turbines, steam engines, steam boats, and other specialities.

MR. ALBERT C. HANDS, 30, Snow Hill, E.C.—Illustrated and priced catalogue of the "A. C. H." artistic electric radiators. Some very good designs appear of radiators finished in wrought-iron and armour-bright iron, with copper and bronze reflectors.

THE PERFECTA SEAMLESS STEEL TUBE CO., LTD., Plume Street, Birmingham.—New catalogue (No. 5) relating to electrical steel conduits and accessories on the "Perfecta" system. In the course of its 104 pages, which are profusely and clearly illustrated, there appear various particulars of sizes, catalogue numbers, prices, &c., well arranged in table form. At the end of the book is a summary of prices of the various tubes and fittings.

MESSRS. FERRANTI, LTD., Hollinwood.—Catalogue No. 63, describing their D.P. single-throw, slow-break knife switches.

MESSRS. EVERSHED & VIGNOLES, LTD., Acton Lane Works, Chiswick.—Circular relating to and giving prices of their insulation testing sets (Meggers). The firm will now undertake to maintain all Meggers bought from them free of charge to the buyer for five years. We believe that so liberal a guarantee is unique; certainly it implies immense confidence on the part of the makers in the durability of their instruments.

HOME RUBBER CO., Balfour House, Finsbury Pavement, E.C.—Small booklet relating to "N.B.O." (which means never burns out and never blows out) packings, including sheet packing, gaskets and rings, pump valves and hose.

MESSRS. BAGSHAWE & Co., 2-3, Tower Royal, Cannon Street, E.C.—Circular relating to B.B. black and red jointing and red tubular gasketing.

MESSRS. WM. MCGEOCH & Co., LTD., 108, Argyle Street, Glasgow.—This firm, who, by the way, will be occupying their commodious new premises in Glasgow in the month of May, have just placed in circulation a large well-bound catalogue which is entirely new, as it has not been issued before even in abbreviated form. On the opening page there appears a view of the new warehouses and offices which form a very large and imposing building; this is followed with some views of the firm's Warwick Works at Birmingham. The catalogue is divided up into 11 sections in which are particularised—with illustrations and prices in every case—main switches and switchboards, distributing and fuseboards, cut-outs, ceiling roses, electric light fittings and numerous accessories, incandescent, arc and Nernst lamps, arc and ship lighting fittings, measuring instruments, wires and cables, bells and telephones, screws and terminals, tools and electric fans. It will be seen that the contents of these several hundred pages cover a very varied field. Among the special

features of which mention may be made are the "Q.B." quick-break knife switches for 600-volt circuits, and the "A.B." high-voltage switch for 250-volt circuits, both in iron cases; also the single-pole service fuses and "Warwick" keyholder. A circular has been issued by the company notifying advances in prices consequent upon the rise in raw materials.

MESSRS. DICK, KERR & CO., LTD., London.—New catalogue fully describing and illustrating in very fine style the company's work in alternating-current generators. Sectional drawings of a 3,000-KW. turbo-alternator, and half-tone views of the stator frame, complete stator and rotor, appear. A list is given of a number of large turbo-plants supplied by Messrs. Dick, Kerr, and one of the complete machines is shown on the works' test bed, as well as some which are running at one of the Glasgow stations. Some appropriate saturation and efficiency curves are shown.

The BRUSH ELECTRICAL ENGINEERING CO., LTD., Loughborough.—The company's enterprise in the construction of steel rolling-stock has been prominently forward of late, and in two new publications which they have just issued there are given collections of excellent views of their work in this direction. One is devoted to a descriptive account with sectional and exterior views of the Sheffield-Twinberrow steel wagons, and self-discharging wagons for gas works, and a brief account of the advantages of steel construction for passenger cars. The other is entitled "Standard Rolling-Stock," and opens with some views of the Brush shops at Loughborough, these being followed with photographs of L.C.C. tramcars, District Railway electric trains, Great Northern and City electric carriages, Central London Railway cars and cars supplied for a Canadian inter-urban line. Other pages contain outline drawings of various types of coaches and wagons, and half-tone views of electric and steam locomotives.

MESSRS. A. REYROLLE & CO., LTD., Hebburn-on-Tyne.—Revised set of pamphlets bound in a file cover, arranged so that new lists can be included as issued. The company's standard manufactures are well illustrated by means of half-tone and diagrammatic views, and are briefly-described, dimensional and other data being tabulated. Quick-break switches, oil switches, voltmeter switches, improved motor-starters for D.C. shunt motors, lever type motor-starters, "Compact" motor switchgear panels, tubular fuse handles, house-service fuse boxes, also many other things, including distributing and dividing boxes, wall plugs, sockets and switchboards are all particularised in the lists. A convenient finger index readily guides the user to the different sections.

The BRITISH ALUMINIUM CO., LTD., 9. Victoria Street, S.W.—Latest price lists for aluminium in various forms—pure aluminium and light alloys in ingots, sheets, rods, bars, wire, &c.

Calendars.—From the ELECTRIC & GENERAL STORES Co., of Sunderland, we have received an artistic wall calendar with monthly slips. Its chief feature is a reproduction in colours of Gerald Ackermann's "Harvest in Sussex."

We regret to find that in our last issue we gave a wrong name in our list of calendars received. The very attractive picture calendar "Lenore," mentioned as having come from Messrs. T. Harding Churton & Co., was actually received from MESSRS. WILSON HARTNELL & CO., of Volt Works, Leeds. Messrs. Harding Churton have not issued a calendar.

Telephone Installation.—MESSRS. J. T. MAYFIELD AND CO., of 63 and 63A, Cannon Street, have just completed a secret service intercommunication telephone installation for the *Tribune* Offices at Bouverie Street, E.C.

Book Notices.—*Willing's Press Guide*, 1906.—This very useful and reliable directory has now reached its thirty-third year. Particulars of all the newspaper, magazine and other publications appearing in the United Kingdom and many of those in other countries, are arranged in alphabetical and classified forms. All who have much to do with the Press, whether by way of advertising business or otherwise, need such a reference work as this. It is published at 1s. by Messrs. James Willing, jun., Ltd., at 125, Strand, W.C.

"One and All Gardening." This very popular twopenny annual which so many amateur gardeners find of interest and service, is issued for 1906. It is, as before, edited by Mr. E. O. Greening, of the Agricultural and Horticultural Association, Ltd., of 92, Long Acre, W.C.

"The Practical Electrician's Pocket-Book and Diary for 1906." London: S. Rentell & Co., Ltd. 1s. net.

"Electricity as Applied to Mining." By A. Lupton, G. D. Aspinall Parr and H. Perkin. Second edition. London: Crosby Lockwood & Son. 12s. net.

Plant, &c., for Sale.—ROBERTSON'S ELECTRIC LAMPS, LTD., of Hammersmith, are changing their factory over entirely to electric driving, and are to take supply from the Borough Council. They are, therefore, offering certain plant for sale, particulars of which appear among our advertisements this week. MESSRS. WHEATLEY KIRK, PRICE & CO. are to sell 4,500 meters for the Marylebone Borough Council; on February 6th they will offer certain machinery and lamps, &c., for sale as announced in our advertisement pages.

New York Electrical Exhibition.—An electrical exhibition was held at New York from December 12th to 24th. Our correspondent states that President Roosevelt assisted in the opening ceremonies by switching on the lighting and power circuits by the operation of a golden key at the White House, Washington. The New York Telephone Co. made an effort to demonstrate the efficiency of their service in view of threatened competition. They showed a section of a central exchange switchboard in operation. Some interesting telephone relics were also on view. A model, 30 ft. long, of the municipal lighting plant and refuse destructor recently erected in New York City for lighting the Williamsburg Bridge, was shown, operated by a motor. The Electric Dynamic Co., Bayonne, N.J., exhibited a new vertical form of interpole variable-speed motor. A model car operated on the Pullen surface-contact system and an electric mining locomotive were shown in operation. This system has been tried, unsuccessfully, at Atlantic City, where the tramway company became insolvent. The Kinsman block system of automatic devices for securing the safe operation of railways was demonstrated. The Chicago Pneumatic Tool Co. had on view a new storage battery with washable cells, fitted with hard rubber screw plugs and soft rubber gaskets. On withdrawing the electrolyte, the cell can be washed by means of a hosepipe. The National Battery Co.'s 1906 model is claimed to be a non-corrodible cell of high capacity, constructed to withstand the vibrations of a fast motor-car. Demonstrations were given by Prof. Earle Ovington, of Boston, on high-frequency currents. The De Forrest Wireless Telegraph Co. showed a 2-KW. set in use, with the instruments which were used on board the *Times* dispatch boat, *Haiman*, in the Russo-Japanese war. Many kinds of domestic appliances were exhibited, together with power and lighting equipments and accessories.

Milan Exhibition.—At the forthcoming exhibition a model street is to be constructed, with the object of showing the best systems of paving for roadway and footway, with provision underground for sewers, water and gas pipes, electric lighting and power, telephone and telegraph cables, arranged in a systematic and well-organised manner. Artistic posts will carry various illuminating sources, including acetylene gas lighting.

The Copper Position.—MESSRS. H. R. MERTON AND Co.'s statistics of copper for the first fortnight of the year point to an alarming scarcity of available supplies of the metal. Stocks are down a further 440 tons to 5,240 tons, and visible supplies have dropped nearly 1,800 tons to 11,190 tons. So low a level has been touched only on very rare occasions in recent years. The curious thing is that imports from North America are still well maintained, notwithstanding the great increase in consumption in the States. Shipments from Chili have been small, and the decline there accounts for most of the loss in visible supplies. The price of Standard remains unchanged at £79 10s.—*Financial Times.*

Imports of Foreign Telegraph Cables.—The value of the foreign telegraph cables and apparatus connected therewith imported into this country during December last only amounted to £4,377 as compared with £6,464 in the final month of 1904. Turning now to the returns for the whole of the past year, it looked at one time as if the imports would have shown a noteworthy increase, those to the end of June being nearly double those of the corresponding half of the preceding 12 months. Each month of the second half had, however, a decrease to its credit, with the result that, although at the end of November, 1905 was still slightly in advance of 1904, the shrinkage in December brought down the figures to £53,532 for the whole of the past year, comparing with £55,074 in 1904 and £57,360 in 1903.

Brush Contracts.—The BRUSH ELECTRICAL ENGINEERING CO. has booked the following contracts:—

Malta (per Macartney, McElroy & Co.).—Five tramcar bodies.
Adelaide (per Electric Lighting and Traction Co., of Australia).—Ten 10-KW. transformers, five 5-KW. transformers.
Warrington.—100-KW. three-phase motor-alternator, one 150-KW. transformer, two 30-KW. transformers.

Trade Announcements.—MESSRS. ANDREW BROWN AND CO., of 110, Cannon Street, E.C., have been appointed the London and district agents for Messrs. Vaughan & Son, Ltd., West Gorton, Manchester, makers of electrical cranes.

The name of the HOWARD CONDUIT CO., LTD., has been changed to the Howard Asphalt Troughing Co., Ltd.

The SIMPLIFIED UNDERGROUND CONDUCTOR CO., LTD., notify that from January 22nd their offices, factory, &c., will be at 180, Crown Street, Liverpool, to which address all letters should be sent.

Dissolutions and Liquidations.—In the Chancery Division at Dublin on the 15th inst., Mr. M'Gonigal applied on behalf of the petitioners, the General Electric Co., London, for an order that the Delmico (Electric Light) Co., Ltd., 5, Dawson Street, should be compulsorily wound up. The nominal capital of the company was £2,000, divided into 2,000 shares of £1 each, the object of the company being, amongst other matters, to acquire the business of certain electrical engineers carried on at 157, Upper Rathmines, under the style of the Modern Electric Appliance Co. The company in question owed the petitioners £45 16s. for goods sold and delivered, and on April 13th last passed a resolution to wind the company up. The object of the petition was to obtain information as to what had become of the assets and how they had been realised. Mr. Matheson, K.C., said if there were a compulsory sale the costs would absorb the assets. Mr. Justice Barton refused the application.

MUSSELBURGH CONSTRUCTION SYNDICATE.—Creditors must send particulars of their debts, &c., to the liquidators (L. B. Schlesinger, 21, Cornhill, E.C., or W. B. Cownie, Queen Anne's Chambers, S.W.) by March 1st.

MESSRS. E. C. WALLIS and E. H. WATSON (Wallis & Watson, electrical engineers, Trinity Street, Leeds) have dissolved

partnership. Mr. Wallis will carry on the business at the same address on his own account, under the old style, and will attend to debts. The motor-car business hitherto carried on at the same address by Mr. E. H. Watson in his own name has been sold and transferred by him to Messrs. George & Jobling, and will be carried on by them at that address on their own sole account, under the same name as heretofore. All debts of the motor-car business will be attended to by Mr. E. H. Watson, at 17, Newman Street, Oxford Street, London.

Pollak-Virag Telegraph Syndicate.—Voluntary liquidation has been decided upon with Mr. W. S. Ogle, of 90, Cannon Street, E.C., as liquidator.

Miller Signal Syndicate (Foreign Patents, Ltd.).—This company is winding up voluntarily with Mr. E. H. Stringer, 110, Cannon Street, E.C., as liquidator.

LIGHTING AND POWER NOTES.

Australia.—Melbourne.—The prices for energy charged by the Council have been tested at law by the Metropolitan Gas Co. The Corporation was making a difference in its charges, some customers paying at the rate of 4½d. per unit and others at 7d. per unit for part of the month and 2d. for the remaining part. The Full Court, following a previous decision, has ruled that under the empowering Act, the Council must not differentiate, and that the system objected to amounts to differentiation.

Brisbane.—The City Electric Light Co., Brisbane, are taking steps to secure the amendment of four Orders in Council granted at different times to the Brisbane Electric Supply Co.—*Australian Hardware and Machinery.*

Birmingham.—The Electric Supply Committee on 10th inst. decided to recommend the C.C. to hire out electric motors.

Brandon.—In reference to our note in last week's issue, the ratepayers have passed a resolution protesting against the action of the U.D.C. in refusing to consent to the County of Durham E.P.D. Co.'s application for a prov. order. Hebburn U.D.C. has decided to oppose an application by the same company for E.L. powers for its district.

Continental Notes.—Italy.—It is interesting to note that the Italian Edison Co., supplying energy from its Paderno works, has during the last four years been able to pay dividends of 13·6 per cent., 14·6 per cent., 14·6 per cent., and 15·33 per cent.; whilst the Lombardy Co., whose works are at Vizzola, has figures for the same periods of 5 per cent., 7 per cent., 8 per cent., and 9 per cent.

A company has just been established in Monza for the production of barium, sodium and potassium by means of electric furnaces, by the new process invented by Messrs. Carcno and Longhi and Prof. Namias. A supply of energy is to be taken from the H.T. conductors of the Conti Electrical Co., Zogno.

The inhabitants of Carrara recently decided that the municipality should undertake the supply of electrical energy. The result of a poll was 2,204 in favour, and 61 against.

The Societá Cooperativa Elettrica Pelegna has secured a concession from the authorities of Aquila, to put down a plant to utilise the water power of the River Vella at Pratola for generating electrical energy for lighting and power purposes.

Germany.—The municipal authorities of Schoneck (West Prussia) have decided on the establishment of an electricity works for the town.

Roumania.—The town of Roman is to be lighted by electricity in the near future.

Spain.—A concession has been granted for the appropriation of water power from the rivers Balon, El Rebollar de la Caband, La Fuente de la Coba, and La Galeria for lighting purposes.

Dublin.—The Corporation, on the recommendation of its Lighting Committee, has resolved to pay Mr. Robt. Hammond the sum of £2,250 in full discharge of all claims by him against the Corporation, he releasing all claims against them as if his agreement of retainer had been unconditionally terminated at June 1st last.

Dunfermline.—The Fife Electric Power Co. has withdrawn its offer to the T.C. in view of the latter body's delay in coming to terms.

Exeter.—The T.C. on June 10th passed a resolution to apply to the B. of T. for a prov. order authorising the Council to supply energy to Heavitree.

Gellygaer.—At a meeting of the U.D.C. on January 10th, a deputation of ratepayers attended and asked the Council to "pause and consider, if not to withdraw," the E.L. scheme altogether. The chairman of the E.L. Committee informed the deputation that in the matter of gas the Council had been badly treated, and it had decided on the question of E.L.

Harrogate.—The electrical engineer has reported to the T.C. that the local electrical contractors have signed an agreement to submit their lamps to the electricity department to be tested and certified, and only to sell such lamps as are certified, those not passing the corporation's specification to be returned to the lamp makers.

Ince.—Wigan T.C. has informed the U.D.C. that it will bear the cost of obtaining the transfer of the Ince E.L. Order, but declines to accede to the request of the U.D.C. to pay a slight rent by way of acknowledgment.

India.—The *Indian and Eastern Engineer* deplores the fact that the many opportunities of a cheap power supply, offered by the water power available in India, are not taken up. There are many industries, whose power requirements are large, situated near very advantageous sites for electric power plant installations, and the Hooghly River district is quoted as an example; this is in close proximity to the Bengal coalfields. However, our contemporary states that a project for the development of a hydro-electric scheme on the River Ravi in the Punjab is contemplated, and a company is to be formed in London to carry out the work. The power station will be erected at the head of the Bari Doab Canal, and transmission lines are to be run to Amritsar and Lahore, distant 70 and 100 miles respectively. The Cauvery power plant, which is supplying the Kolar Goldfields, is meeting with phenomenal success.

Lancashire.—The past year has been one of much progress in regard to electrical power supply in Lancashire. The mains laid and to be laid by the Lancashire Electric Power Co., cover an area nearly 40 miles from the generating station at Outwood. At the present time the cables of the company have reached Edenfield, and will be laid across the moors in the direction of Whitworth, through Heywood and to Outwood. There will be connections to Haslingden, Waterfoot, Rawtenstall, Bacup and Stacksteads. From Ramsbottom the mains are being carried across the Holcombe moors to Turton, through Little Lever to Little Hulton and West Houghton; thence to Newton-in-Makerfield, and returning by Leigh, Tyldesley, Worsley, Swinton and Pendlebury, where the first English chimneyless cotton mill is now being supplied.

A conference of local authorities, within the company's area of supply, is to be held to consider whether joint action shall be taken with regard to the Bill of the Lancashire Electric Power Co. Wigan T.C. will oppose the Bill with the object of having the town absolutely excluded from the area, and Ince U.D.C. will co-operate in this opposition.

London.—Fulham.—Some trouble has been caused at the B.C. station by the break-down of the Belliss engine. At the time the turbo-generator was under examination, and the engineer stated recently that in consequence the remaining plant was overloaded to the extent of 40 per cent., and to avoid a serious breakdown three arc circuits were switched off. It is satisfactory to note, however, that private consumers were not inconvenienced. Mr. Fuller remarked that there is only sufficient plant to cope with the winter's load, making it impossible properly to overhaul any of the sets.

L.C.C.—Credit is due to the Holborn B.C.; it has awakened to the true state of affairs in regard to municipal trading. On the 10th inst. the recommendation in favour of opposing the L.C.C. electric supply scheme was carried by a large majority. Councillor Simmons observed that "they had had some experience lately of L.C.C. trading with regard to steamboats," and Councillor Heckscher said "they objected to becoming guarantors for any C.C. schemes."

Hackney.—The B.C. is to take up a loan of £1,200 for E.L. installations.

Bermondsey.—During the year the lamps connected to mains from private consumers amounted to 53,969, and for public lighting 4,646, a total of 58,615. The highest load observed for 1905 was 682 kw., and for 1904, 538 kw.

The Thames.—The Thames Conservancy Board has granted permission to the South Metropolitan E.L. and P. Co., to place two 30-in. suction and discharge pipes, with inlet chambers in the foreshore off their premises at East Greenwich, also to the Twickenham and Teddington Electric Supply Co. to lay a cable at a depth of 18 in. under the river bed and towpath from Twickenham to Ham.

Shoreditch.—Application is to be made to the L.C.C. by the Council, for an advance of £14,905, being the balance of a loan of £91,905, sanctioned in respect of the electricity undertaking. It has also been resolved to apply to the L.C.C. for sanction to borrow an additional sum of £23,555 for E.L. purposes.

Paddington.—The B.C. on the 16th inst. considered a recommendation by a Committee, that the tender of the Metropolitan Electric Supply Co., at £636, for carrying out the electric lighting of the Town Hall, be accepted. During discussion it was alleged that the company was subletting the contract, and the matter has been referred back.

Lowestoft.—There are now 661 consumers connected with the mains, representing 33,668 8-c.p. lamps. The revenue of the undertaking for the past financial year was £11,688, as compared with £9,829 in 1904. The gross profit realised in 1905 amounted to £4,139, as compared with £2,322 in 1904. After providing for capital charges, a deficit of £550 remains, as compared with a deficit of £1,471 in 1904. The Committee has lately agreed to supply energy to the tramways at a reduction of ¼d. per unit.

Northants.—The County of Northampton Electric Power and Traction Co. is applying to the B. of T. for a prov. order to supply energy in the districts of the Higham Ferrers T.C., Rushden U.D.C., and Wellingborough R.D.C. The C.C. on January 11th decided to ask for clauses protecting the Council as the main road authority.

(*Continued on page 103.*)

THE BELFAST TRAMWAYS UNDERTAKING.

In February, 1905, the Corporation of Belfast commenced to relay, extend and electrify the tramways in that city, having acquired the undertaking from the old company under an Act passed during the session of 1904. The amount paid by the Corporation was £364,448.

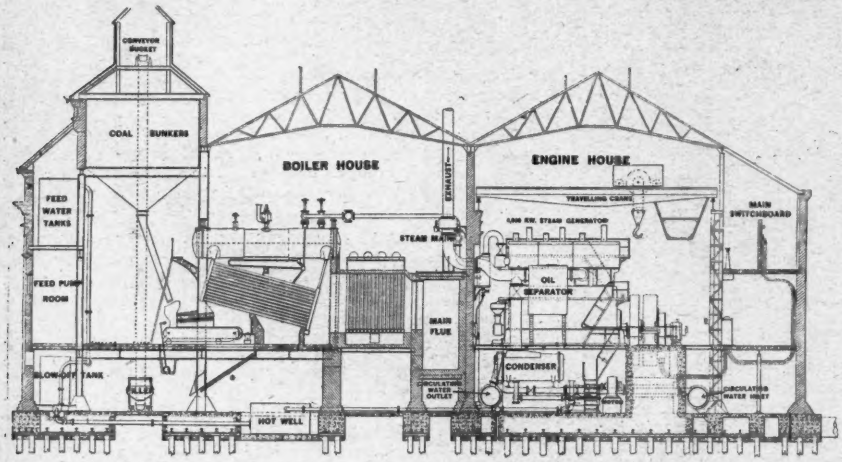


Fig. 1.—Sectional Elevation of the Tramway Power Station Extension.

After considering reports by Mr. Henry A. Cutler, M.Inst.C.E., the city surveyor, and Mr. V. A. H. M'Cowen, M.Inst.E.E., the city electrical engineer, the overhead trolley system was adopted.

The specifications were submitted to Messrs. Lacey, Sillar & Leigh for expert advice, and tenders were invited for the work of reconstruction and electrification of the tramways, excluding the buildings, in six different sections, and eventually the tender of Messrs. J. G. White & Co., of London, for the whole of the six sections, amounting to £543,404, was accepted.

In reconstructing the permanent way all the routes were laid as double line to a gauge of 4 ft. 9 in., and the work now completed consists of about 80 miles of single track. Sixteen single-track miles of the tramways were laid only five years ago, and as this portion of the work was in fair condition, the renewal of the special work, bonding and general repairs was the only work necessary in connection with it.

British standard sections were adopted for the rails and fish-plates used in the new track, the rails weighing 105 lb. to 111 lb. per yd.

Cooper anchor joints and intermediate anchors are used on the track, the joint bonding of which has been executed with 0000 B. & S. gauge copper bonds of the protected type, two bonds being fitted to each joint, and solid crown cross bonds spaced at 40 yd. intervals in the tracks and 80 yd. intervals between the tracks.

The whole of the special track work was manufactured and supplied by the Lorain Steel Co. of America.

A somewhat novel method of laying the track was adopted. When the necessary excavation had been completed, the rails were put in position, the fish-plates, anchors, tie-bars and bonds fitted, and the rails packed temporarily in the usual way. Plastic concrete packing was put under the anchors, and left for about 24 hours to set. The concrete bed was then put in in the usual way, and packed tight under the rails while in a plastic state, the temporary packing being withdrawn in front of the concrete gang instead of after the concreting had been completed.

A 7-in. concrete bed was provided under the rails; the paving in between, being of granite setts. In carrying out the work, numerous alterations had to be made to sewers, gas, water and other mains, and in two places roads had to be lowered to provide the proper headway under bridges.

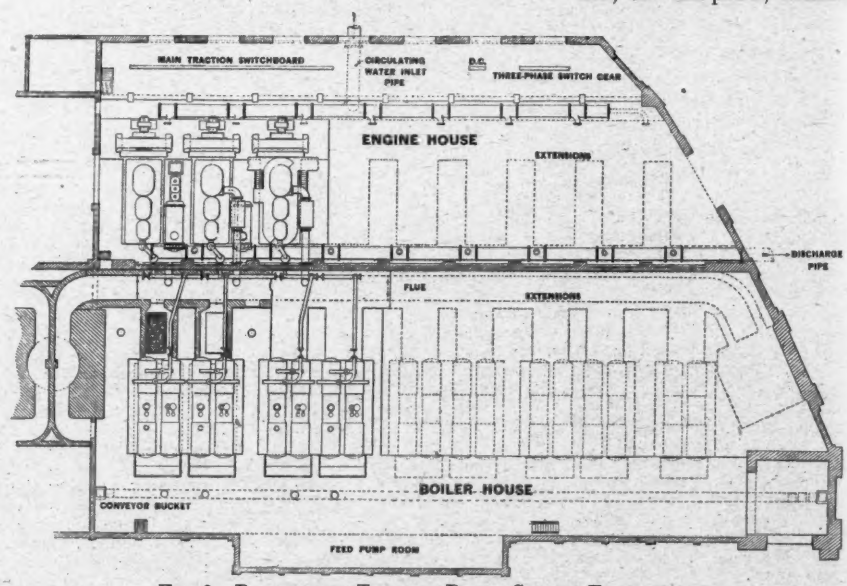


Fig. 2.—Plan of the Tramway Power Station Extension.

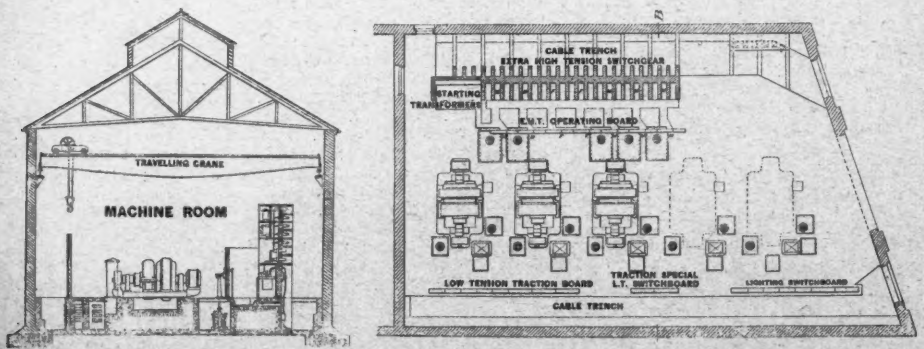


Fig. 3.—Sectional Views showing the Arrangement of the Fort William Sub-Station.

The overhead equipment was carried out by Messrs. J. G. White & Co., and the greater portion is of span wire construction with the exception of $2\frac{1}{2}$ miles of side bracket, in outlying districts, and $2\frac{3}{4}$ miles of centre pole construction in the wide main thoroughfares in the centre of the city.

The trolley wire is double throughout, and flexible suspension is adopted in all cases, arranged for centre running on all span work, the maximum deviation allowed in any case being 6 ft. from the centre of the track.

The sectional insulators are of the straight under-running air-gap pattern, and duplicate insulation is employed in all cases.

Guard wiring has been reduced to a minimum owing to the Corporation, on the advice of Mr. M'Cowen, having required the Telephone Co. to put all their telephone wires on tramway routes underground.

Section feeder pillars are placed at $\frac{1}{2}$ mile intervals on all routes, and at shorter distances in the centre of the city to suit local conditions: the pillars are arranged for double insulation, and are provided with both traction and telephone switchgear.

A small separate door is provided for getting to the telephone plug boxes, and owing to trouble from damp experienced with telephone instruments placed in pillars, the usual method has been departed from, and plug boxes only are provided in the pillars.

The instruments themselves are provided with an induction coil in the handle, and an instrument is carried on each car, which can be plugged on to any pillar, and communication made with the power house or car-sheds as desired.

The overhead equipment in the car-sheds and the approaches to the same has been carried out by Mr. M'Cowen's own staff, and mechanical ears have been here employed throughout. In some of the larger sheds one trolley wire is arranged to serve two lines of track with a view to reducing complications in the overhead special work, and as in one case as many as 17 tracks are taken off the two approach tracks, and in another, 20 tracks are taken off a single track, the possible complications of overhead equipment can be imagined.

The overhead supply to each shed is separately metered, so that the energy used in the sheds can be carefully watched, and the shed approaches are brilliantly lighted by means of arc lamps.

Four existing car depôts have been reconstructed and a new one built, which will together be capable of housing some 380 cars. 170 double-deck single truck cars have been supplied by the Brush Co., with standard electrical equipment by the British Westinghouse Co. Hand, slipper and rheostatic brakes, and Hudson and Bowring lifeguards are fitted to each car.

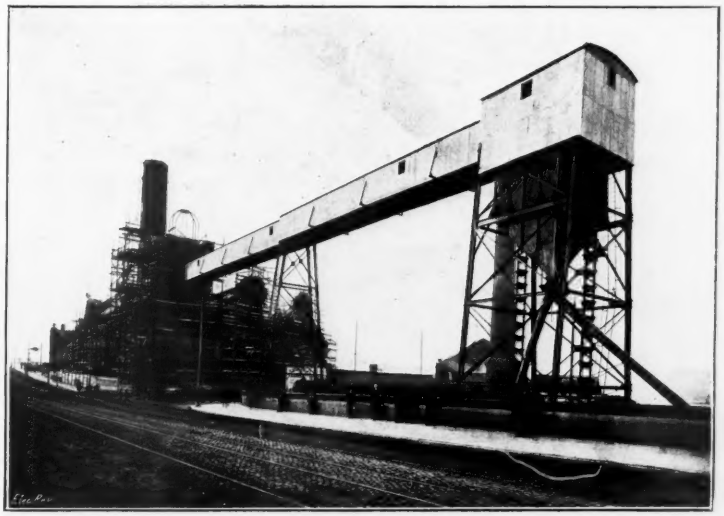


Fig. 4.—Exterior of Power Station, showing Coaling Plant.

In addition to the above, 50 horse cars are being converted for electrical working, with Westinghouse equipments.

The site of the tramways power house building adjoins the electric light station, and is very centrally situated, close to the bank of the River Lagan, which is navigable for coal barges to the site of the works, and will provide an unfailing supply of water for condensing.

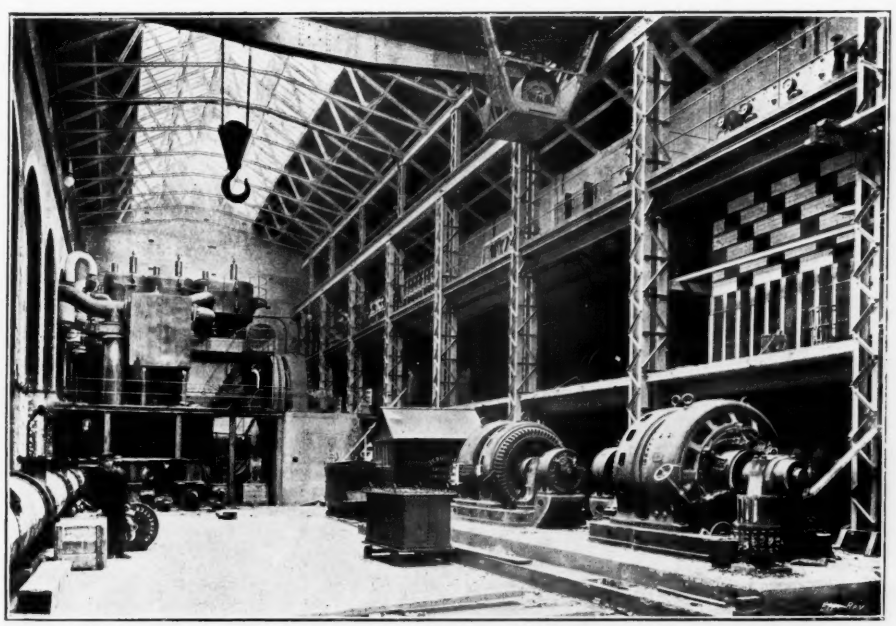


Fig. 5.—Interior of Engine Room, showing the Motor-Generator Plant and Switch Gallery

The foundations are formed with cement concrete in which is embedded a steel grill work made of old tram rails, on the top of 30 ft. piles. The frame-work of the building is made of steel and the roof and floors were erected before the brickwork was commenced, which enabled the coal bunkers, boilers and engines to be installed during the time the building was being erected.

The new station forms an extension of the central electricity works which was erected in 1898, this site at the time being recommended by Mr. M'Cowen as a suitable point for distributing energy for the city's requirements both for lighting and traction purposes. All the plant installed has been arranged for both lighting and traction supply: the generators are provided with compound windings for tramway supply at 550 volts, the lighting pressure being 440 to 500 volts on the outers of the three-wire system, and provision has been made on the traction switchboard for controlling three large lighting generators.

F

The plant in the original works consists of high-speed steam dynamos having a total capacity of 3,400 KW.; the engines throughout are by Belliss & Morcom, the dynamos being by Mather & Platt, Parker, and Johnson & Phillips.

The boiler house plant includes six Lancashire and six water-tube boilers, together with economisers and steam and electrically-driven feed pumps.

FIG. 6.—INTERIOR OF CAR DEPÔT.

The condensing plant is of the Wheeler combined type with steam-driven horizontal air and circulating pumps placed below the condenser, the cooling water being obtained from Wheeler and Klein cooling towers.

The new boiler house contains a single row of Babcock and Wilcox boilers placed in batteries of two; each boiler is provided with its own superheater and a 128-tube Green economiser immediately behind, opening direct into the main flue.

Each boiler has a heating surface of 5,764 sq. ft., with a grate area of 100 sq. ft., and is capable of evaporating from 20,000 to 25,000 lb. of water per hour, to steam at 200 lb. per sq. in. pressure, and superheated to 150° F.

The boilers are equipped with chain-grate stokers, driven through a line shaft from duplicate electric motors.

The coal-handling plant consists of a 50-ton endless bucket conveyor of the gravity type, running over the bunkers and under the firing floor and extending to a hopper on the quay. The coal is brought alongside the quay in barges, and is there discharged by means of a grab operated by an electric locomotive crane which deposits it into the hopper of an "Ingrey" automatic weighing and recording machine, which discharges into a receiving hopper underneath. From this hopper the coal passes into an automatic filler which fills the buckets of the conveyor. The overhead bunkers have a capacity of 1,000 tons of fuel, which is fed through shoots to the hoppers of the chain-grate stokers.

The conveyor is also available for the removal of ashes from the boiler basement; the ashes being deposited in a storage hopper on the river side.

The arrangement of steam pipe work is extremely simple each boiler, economiser and steam dynamo forming a unit, connected by an 8-in. steam-pipe. A 10-in. main steam-pipe in the boiler house links up the branches, and acts as an equaliser between the various units.

The pipes, which are of weldless mild steel, are arranged to obviate the undesirable necessity of steam traps, each section of pipe-work draining to its own engine separator, which is protected by a trap.

The valves on the boiler are arranged so that either "raw" or "superheated" steam can be taken, and Hopkinson valves, with outside screw spindles, are employed throughout. A duplicate system of feed is provided to the boilers, supplied from the Water Commissioners' mains.

Duplicate suctions are taken from feed tanks to the pumps, and duplicate deliveries are run between the pumps and the boilers; one of the deliveries is connected through a 6-in. Railton & Campbell pressure feedwater filter, a 6-in. Kennedy water meter, and an auxiliary heater (which takes the exhaust from the steam pumps) to the economiser, and thence to the boilers; the other delivery is direct.

One Hall compound vertical steam pump capable of delivering to the boilers 8,000 gallons, and two Hayward-Tyler "Sinclair's" electrically-driven variable-stroke pumps, each capable of delivering 8,000 gallons per hour to the boilers, are installed.

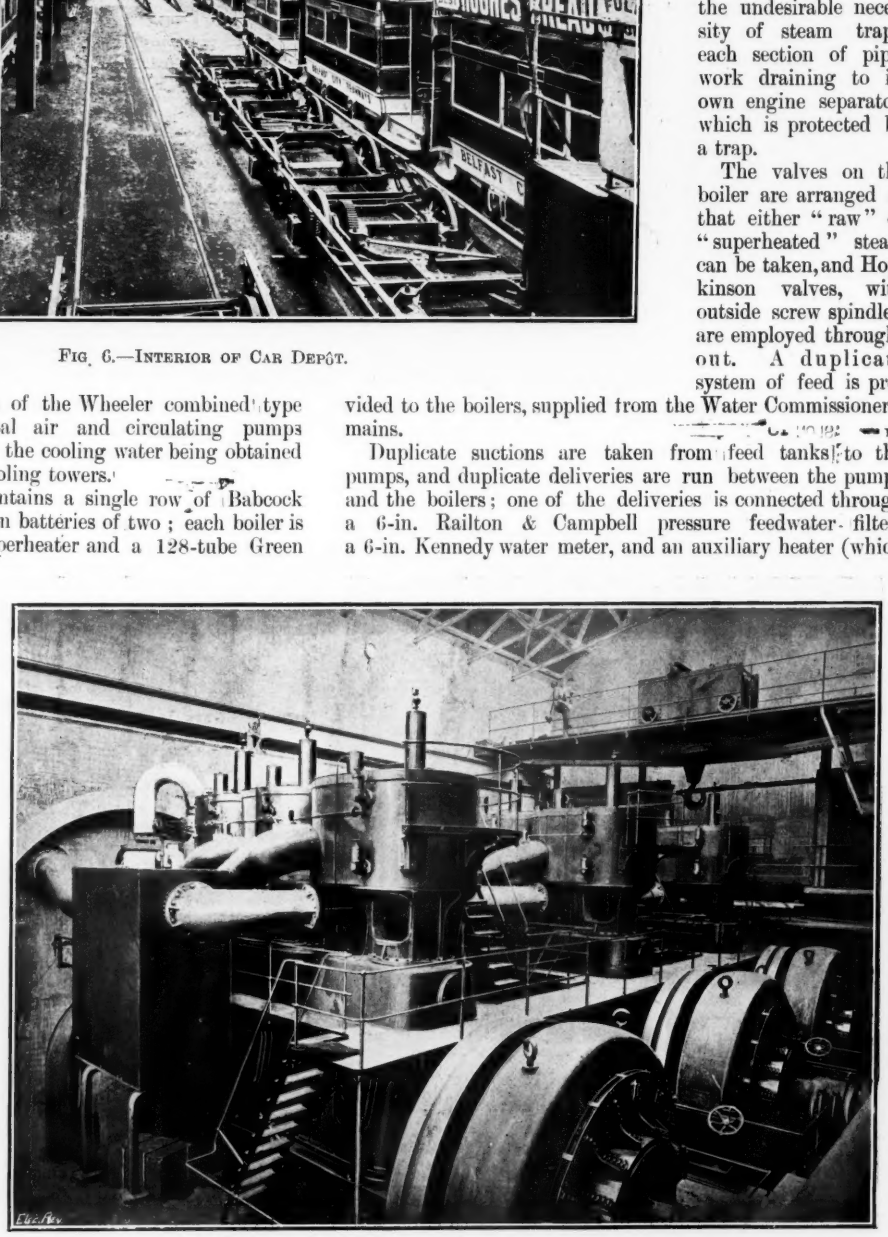


FIG. 7.—1,000-KW. COMBE-BARBOUR-WESTINGHOUSE TRACTION GENERATORS.

The following are the guaranteed figures for the feed pumps: — Steam, 110 lb. of water pumped per lb. of steam; electric, 3,600 lb. of water pumped per Board of Trade unit.

The new tramway generating plant consists of three 1,000-KW. direct current steam dynamos. The engines are of the vertical inverted three-crank triple-expansion enclosed type, with forced lubrication, by Messrs. Combe, Barbour, Ltd., of Belfast, and constructed to run at a speed of 180 r.p.m. The cylinder dimensions are 22 in., 33 in. and 50 in. × 24-in. stroke. The steam consumption at full load condensing, and with 25 in. of vacuum, is guaranteed at 16¾ lb. per KW.-hour, subject to additions or deductions of £250 per engine for every pound of steam per KW.-hour below or above that figure.

FIG. 8.—TRACK WORK UNDER CONSTRUCTION AT GROSVENOR ROAD JUNCTION.

The condensing plant is of the counter-current surface type, manufactured by Messrs. Mirrlees, Watson & Co. The circulating water is obtained from electrically driven pumps, arranged in a pump house on the river bank. Three Gwynne electrically driven centrifugal pumps are at present erected, two 12-in. and one 15-in., and provision is made for the erection of two more when required.

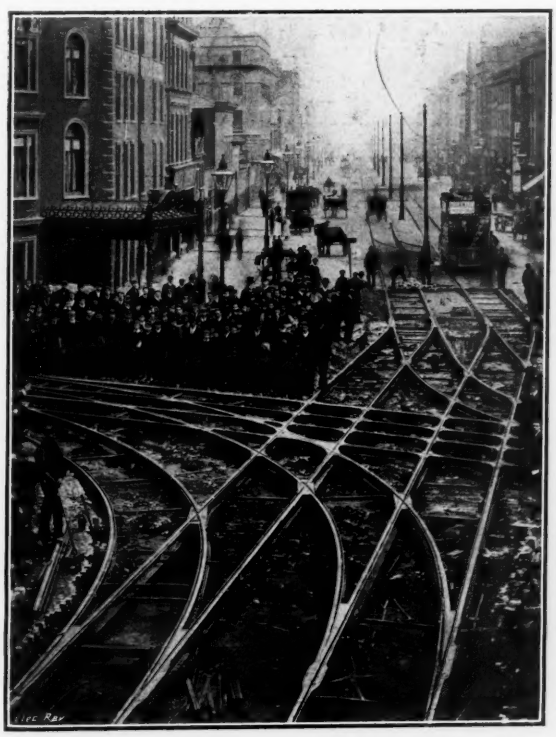


FIG. 9.—SPECIAL TRACK WORK AT JUNCTION OF DONEGAL ST. & YORK ST

The 12-in. pumps are each direct coupled to a 30-B.H.P. motor, and will deliver 150,000 gallons per hour. The 15-in. pump is coupled to a 50-B.H.P. motor, and will deliver 300,000 gallons per hour, the height of lift varies about 9 ft. with the state of the tide, but the maximum is not greater than 15 ft. A 36-in. steel pipe is laid between the pump house and the generating station, connections being provided for the ultimate requirements of about 12,000 H.P. The discharge pipe, which is of similar size and material, is brought back to the river higher up, the discharge being led in below low-water level to get the benefit of the siphon action.

Two sets of Gwynne-Sargent motor-driven patent charging apparatus are also provided in the pump house for priming the pumps.

Each main engine is provided in the basement with a separate condenser, having 2,350 sq. ft. of cooling surface, and an electrically direct-driven three-throw Edwards air pump. The discharge from the air pump gravitates into a large cast-iron tank in the boiler house basement, and is lifted from thence to a hotwell over the feed pump house, by means of electrically-driven centrifugal pumps.

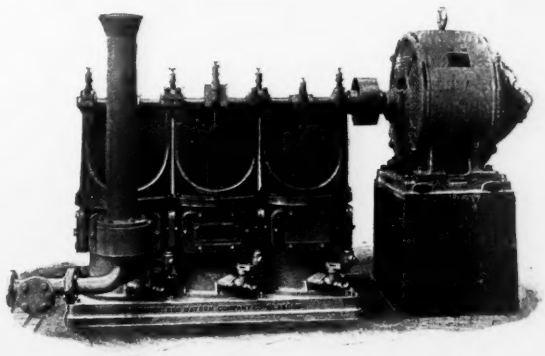


FIG. 10.—MIRRLEES-WATSON MOTOR-DRIVEN AIR PUMPS.

FIG. 11.—VIEW OF OVERHEAD CONSTRUCTION.

An exhaust steam grease separator is placed between the engine and the condenser, each engine being also provided

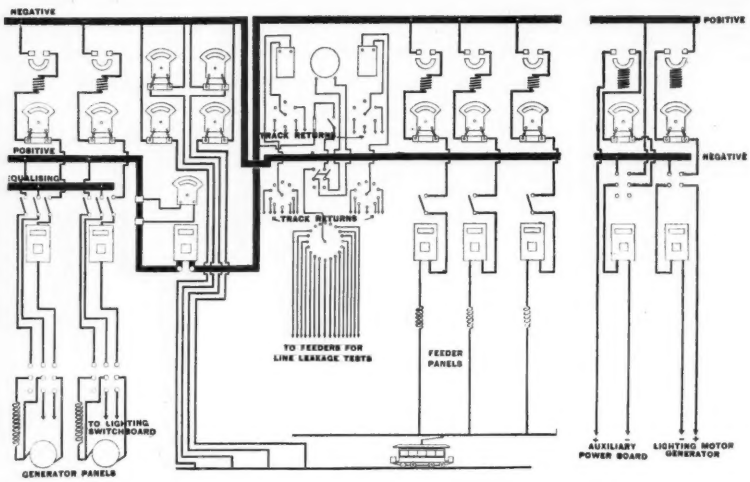


FIG. 12.—GENERATOR, FEEDER, AND SPECIAL PANEL CONNECTIONS: MAIN SWITCHBOARD.

with an atmospheric exhaust controlled by an automatic valve, which opens in the event of the vacuum failing, so that the plant can run non-condensing.

The generators are of the Westinghouse 16-pole type, wound for a constant voltage of 550 when running compound for traction purposes, and 450 to 500, when used for lighting purposes. These sets are capable of withstanding 25 per cent. overload for short periods and a 50 per cent. momentary overload.

In addition to the above plant, two 250-KW. three-phase synchronous motor-generators are installed in the power station: these machines are supplied with direct current from either the traction or lighting switchboards at a pressure of 500 to 550 volts, and generate three-phase current at 6,000 volts, 50 cycles, for transmission to a sub-station at the Fortwilliam depôt which is used for operating a portion of the system in that district, and for supplying the Cavehill and Whitewell Co.'s line.

The three-phase generators are of the Westinghouse 12-pole revolving field type, and are coupled to six-pole D.C. motors. An exciter is provided on one end of each shaft, and the speed of the sets is 500 r.p.m.

Three 125-KW. three-phase synchronous motor-generators are installed in the sub-station, these are similar to the above, with the exception that each is provided with a small three-phase induction starting motor mounted on the other end of the shaft.

The main traction switchboard and the three-phase operating switchboard in the power station were supplied by the British Westinghouse Co., and are erected on a gallery which runs the full length of the engine room at a height of 12 ft. above the main floor level.

The panels are of white marble and include three 500-KW. and three 1,000-KW. generator panels, a main meter panel, a Board of Trade panel, eight panels for controlling 16 feeders and an auxiliary power and lighting panel.

The switch arrangement follows the usual standard design; each route is supplied through a separate feeder which can be separately metered.

The three-phase switchgear, both in the power and sub-station, is of the Westinghouse remote controlled oil-switch type frequently described in these columns. The H.T. oil switchgear is entirely enclosed and provided with automatic tripping gear energised by means of series transformers placed in the main circuit.

Duplicate three-phase bus-bars are provided, which can be connected to any generator or feeder by means of selector switches.

Provision is made for starting up the motor-generators from the D.C. side.

The sub-station is situated about three miles from the generating station, and is connected by means of duplicate E.H.T. three-core trunk mains, the section of each core being 0·075 sq. in. These are lead-covered and armoured, and laid in earthenware troughs filled in solid with bitumen.

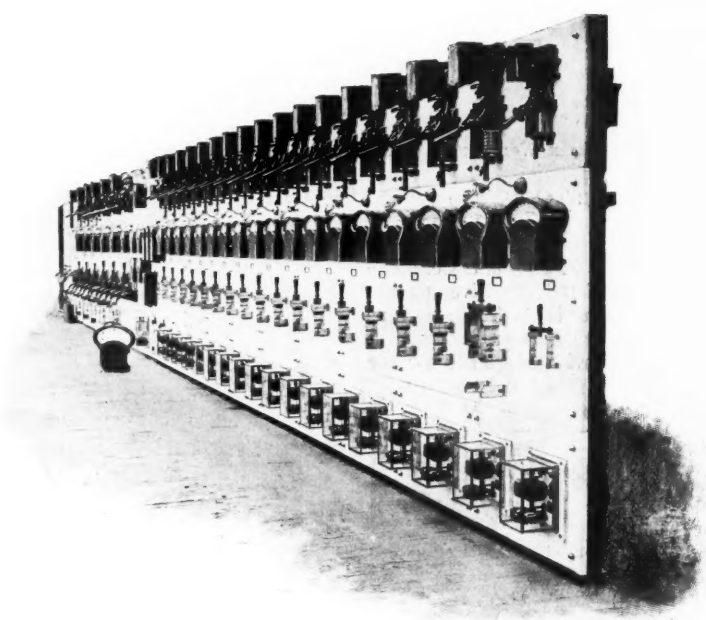


FIG. 13.—MAIN TRAMWAY SWITCHBOARD, BELFAST.

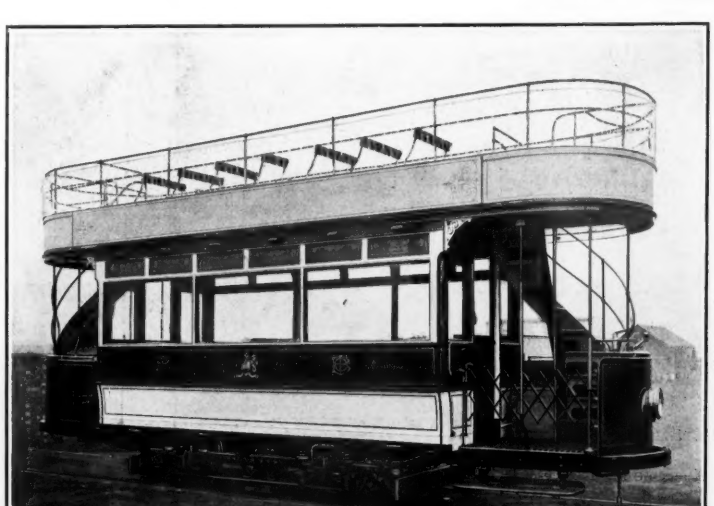


FIG. 14.—STANDARD BELFAST CAR.

The feeder cables are of Callender's well-known bitumen insulated type, laid solid in earthenware troughs.

Two cables only are laid in each trough, the arrangement throughout being, the feeder telephone and test wire for the same route placed in the same trough.

There are 16 line feeders, and four rail return feeders, the system of distribution being a line feeder for each route, and two line feeders to the central district of the city. The rail return feeders are taken to four of the principal junctions.

The lengths of the feeders vary from 1,500 yards to 7,500 yards, and the sections vary from 1 sq. in. to ·15 sq. in. of copper. The section of the rail return feeders varies from 2½ sq. in. to 1½ sq. in. depending on the load in the various districts.

In conclusion, our thanks are due to Mr. V. A. H. M'Cowen, the chief electrical engineer to the Corporation, for the information contained in this article, and to Messrs. J. G. White & Co. and the British Westinghouse Co., for the photographs here reproduced, of which figs. 8 and 9 are from photos by Mr. C. H. Halliday, of Belfast.

LIGHTING AND POWER NOTES.

(*Concluded from page* 97.)

Kearsley.—The U.D.C. has asked the B. of T. to extend the E.L. order for another year.

Lichfield.—With regard to the Bill of the Shropshire, Worcestershire and Staffordshire Electric Power Co., the T.C. has decided to object to the city being placed in the rural area which is subjected to the highest maximum charge for energy. Steps are to be taken to ensure the city being placed either in the industrial area or in that of city and county boroughs.

Maidstone.—It is proposed to hold an electrical exhibition in the town in about two or three months' time.

Mexico.—According to the *Journal of Commerce* (N.Y.), construction work is to be commenced immediately by the Parral Power and Reduction Co., which has taken over the concessions held by Eugene Davies, of Washington, upon a 5,000-H.P. plant in the State of Durango, 51 miles from Parral, which will furnish electric power to Parral, Santa Barbara, Inde and Guanacevi, and a 1,000-ton reduction plant at Parral. Orders have been placed for the machinery for both plants, and it is estimated by the company that it will have to immediately construct three additional mills of 1,000 tons capacity each, to handle the ores which are now offered, and more may have to be constructed in other districts.

Portslade.—The Joint Committee of the Shoreham, Southwick and Portslade U.D.C.'s in a report on the E.L. scheme, states that the terms upon which the Brighton Corporation proposes to supply energy are unacceptable, and better terms are to be pressed for.

Sandgate.—The U.D.C. recently discussed the Kent Electric Power Bill, 1906. The Council agreed that "The Folkestone Electricity Supply Co. would be the people mainly to benefit by the Council's opposition," and resolved to ask the supply company, in the event of the U.D.C. opposing the power Bill, if it will agree to pay the costs.

Scottish Notes.—The paper mills are slow to scrap their steam engines and shafting, but the Clyde Valley Power Co. has already one paper mill taking about 450 B.H.P.

An excellent example of the influence now exercised by electric power in shipbuilding yards on the Clyde, is furnished by the repairing of the Orient liner *Omrah*. This steamer is in the Govan public graving dock for a heavy hull repair, and the Fairfield Shipbuilding Co. have laid down electric plant specially for the working of electric drills and rivetters, &c., power being obtained by a temporary connection with a cable leading from the Govan Corporation generating station. This is the first time this has been done in a public graving dock on the Clyde.

Southampton.—The T.C. has received from the L.G.B. sanction to a loan of £6,291 for E.L. purposes. The sum was made up of £4,744 excess of expenditure over loans already sanctioned, and £1,547 for work carried out in anticipation of sanction.

South Wales.—A breakdown occurred recently on the South Wales Electrical Power Co.'s system at Tonypandy, probably through the recent heavy rains causing a slight land subsidence which separated two lengths of cable.

Sunderland.—*Apropos* of our note last week in regard to a proposal by a company—the County of Durham Electric Power Supply Co.—to take over the Corporation undertaking, Mr. Snell, the Corporation electrical engineer, has stated that he is of opinion that it could not be economically carried out. The terms were that the committee should lease to the company the sub-stations and future sub-stations, and the company would supply the Corporation with electricity generated on the Tyne. The Corporation would supply the private consumers, the shipyards and the works. The company would pay £12,000 per annum for the stations and sub-stations, and any sub-stations that might be required, and which the Corporation would have to build. The municipality would have to pay the existing interest and sinking fund, which for this year amounted to £19,707, and pay for the energy supplied by the company. "He thought the Council would agree that it was not desirable he should state the price. He might say that this year and next year there would be a slight advantage to the Corporation, but there would be no advantage after, rather a disadvantage." This year the output of the Council's undertaking is six million units. One of the company's conditions was that having reached a demand of a certain amount, the Corporation must pay for that amount for a term of 21 years whether they required it or not, the only margin allowed being 10 per cent. He pointed, too, to the risks which would be attendant on a breakdown in the system between Sunderland and Newcastle. The Committee's suggestion was accepted, and the offer was refused.

Thornaby-on-Tees.—The B. of T. has approved of the transfer of the U.D.C.'s prov. order for E.L. to the Cleveland and Durham County E.L. Co.

Truro.—The National Provincial Electricity Corporation has informed the T.C. that the application for a prov. order for E.L. will not be proceeded with this session.

Tunis.—The Cie. Electrique de Sousse has formed a sub-company with a capital of 150,000 fr., to erect an electricity works at the coast town of Sousse.

U.S.A.—NIAGARA FALLS, N.Y.—The Niagara Falls Electrical Transmission Co. is increasing its capital from £200,000 to £1,000,000, and plans to construct new lines with a capacity for the transmission of at least 50,000 KW. are being drawn up. This company distributes in contiguous U.S. counties for the Electrical Development Co., of Ontario, Ltd. It was stated in the Governor's annual report, to the N.Y. State Legislature, that the Dominion of Canada and the State had been engaged in an unworthy rivalry in granting franchises of incalculable value to power development companies, permitting them to take water from the Niagara River above the Falls for commercial purposes; these privileges constituted a real menace to Niagara. International agreement was advocated to protect the cataract from spoliation.

The N.F. Hydraulic Power Co. has made a contract to supply 27,000 H.P. of electrical energy to the Pittsburg Reduction Co. by January, 1907. The company is to build a large factory at Niagara Falls for the manufacture of aluminium wire.

CLEVELAND, OHIO.—On January 2nd, energy from the new city lighting plant was used for the first time in the council chamber.

NORTH CAROLINA.—The Southern Power Co. has contracted for the equipment of the first of nine power plants to be built on the Catawba River. This station will have a capacity of 40,000 H.P.

Willington.—The U.D.C. has decided, with reference to the application for a prov. order for E.L. by the Durham Electric Power Distribution Co., to object to the laying or placing of H.T. mains overhead, and to the company obtaining a monopoly in the district.

Woodford.—The U.D.C. has decided to oppose the application of the National Provincial Electricity Corporation, Ltd., for a prov. order for E.L.

TRAMWAY AND RAILWAY NOTES.

Belfast.—Major Pringle, on behalf of the B. of T., has completed the inspection of the Corporation system, and has expressed satisfaction with the work. The Corporation has received the draft proposals from the promoters in regard to the proposed service between Belfast and Holywood, and the Committee has agreed to supply electricity on the same terms as given to the Cavehill and Whitewell Tramways Co. The average price received for 20 tramcars sold by public auction was £3 10s. 3d.

Birmingham.—The B. of T. has waived its objections to the use of top covers on the electric cars, and 150 of the new cars will be provided with them; the other 50 are too far advanced to admit of this.

Bath.—The Bath Electric Tramways Co. have put motor-omnibuses on the roads as feeders to their trams. Three services have been started, to Bradford-on-Avon and Trowbridge (9 miles), to Corsham and Chippenham (11 miles), and to Box and Melksham (9 miles). The next services to be started will be from Coombe Down to Frome (11 miles), and up Lansdown, a hill which has hitherto baffled every form of mechanical traction. The vehicles used are 30-horse Milnes-Daimlers, double-decked. The Bristol Tramways Co. are about to imitate the Bath Co.—*Motoring Illustrated.*

Continental Notes.—HOLLAND.—Rapid progress is being made with the conversion of the horse tramways in the town of Rotterdam to electric traction, and work is well in hand with the erection of the power station which is being built by the municipal authorities. As this will not be ready for some time and as one line is ready for work, a temporary plant is being put

down to supply the current for this section, which it is expected will be in operation by the end of May.

France. — On the 9th inst. eighteen passengers were injured by jumping from a runaway train on the funicular railway in the Belleville quarter of Paris. Almost immediately after the train, consisting of two cars, started down the steep hillside, the brakes refused to act, and the train dashed at great speed towards the Place de la République. In trying to work the emergency brake one of the conductors was thrown out and badly hurt. The passengers nearest the driver sat tight, but many jumped out of the second car. All these were badly hurt. The train ran off the rails and came to a stop on the Boulevard de la Villette, and the passengers who remained in the car escaped with a severe shaking. This accident is the first of the kind during the fourteen years the railway has been in existence.

Croydon.—There are indications that considerable progress will be made in the extension of the tramway system during the current year. The B.E.T. Co. are erecting the posts to carry on the line from the portion recently opened at South Norwood to Penge, and the construction of the Penge line has been continued up Beckenham Road to the Crystal Palace; a junction has also been commenced along the Anerley Road to take the line up to Upper Norwood, to the boundaries of Croydon and Camberwell in that direction. The span wire system is being adopted for this district. A further extension of the Croydon system has been commenced to carry the line over Mitcham Common to Mitcham, where the London boundary will be tapped in another direction. There are also signs that the Croydon Corporation may be induced to extend the lease now held by the B.E.T. Co., which expires in May next, as a much more friendly feeling has grown up between the parties, and it would obviously be to the advantage of the company to give up the greater portion of their profits in running the system within the Croydon boundary, in order to control the system in connection with the extensions to outside districts now in course of construction.

Cuba.—The Cuban *Gaceta Oficial* notifies applications by Mr. G. F. Greenwood, the representative of the Cuban Electric Co., for permission to construct: (1) a tramway line in Regla; (2) two tramway lines in Guanabacoa. These lines are to be connected with the tramway between Regla and Guanabacoa.—*Board of Trade Journal.*

Douglas.—The Corporation is exercised over the tramway question. The Manx Electric Railway Co. has offered to electrify the horse and cable tramways and to run them for 14 years, but the T.C. has rejected the proposal, and has decided to obtain expert advice on the matter.

Dublin.—The B. of T. having received a report from Lieut.-Col. von Donop as to the authorised speeds of the tramcars, proposed a revised scale allowing 12 miles an hour in certain parts; the Paving Committee submitted a report in accordance therewith, but owing to opposition in the Council, it was withdrawn.

East Ham.—Negotiations with regard to the proposed purchase by the T.C. of the North Metropolitan Tramways in the Romford Road are in progress.

Falkirk.—In connection with the proposed extension of the Falkirk and District Tramways to Grangemouth and Laurieston, for which a prov. order is being promoted by the Tramway Co., a basis of settlement has been provisionally agreed upon by the T.C. in connection with its opposition to the order, under which the sum of £1,500 is to be paid by the company to the Council before the work begins, and £3,500 before any extension of the system beyond Laurieston or any junction with other lines is made, this amount to be expended on widening the route of the tramway at such time and in such manner as the Council may think fit; also that £100 be paid by the company to the Council in payment of the expenses in connection with its opposition. Over and above this the company will carry out the widenings provided by their order, amounting to the sum of £2,500 or whatever these may cost.

Glasgow.—The T.C. has decided to petition against the Bill of the Glasgow and South-Western Railway Co., in which powers are sought to run motor-omnibuses for public traffic.

Huddersfield.—The borough treasurer's financial statement respecting the tramways for the nine months ending December 31st last shows a capital outlay to date of £414,667. The miles run are 1,318,786, compared with 1,272,682 last year. The income is £56,750, or 10·33d. per car-mile, against 10·20d. last year. The expenditure is £28,913, or 5·26d. per car-mile, against 5·00d. last year. The gross surplus is £27,837. Rent of leased lines absorbs £904, interest on capital £10,170 and redemption of debt £7,312, leaving a net surplus of £9,451, or 1·72d. per car-mile, against 1·67d. last year. This statement does not include any provision for depreciation.

Hythe.—The T.C. has given its consent to the tramway scheme promoted by the National Electric Construction Co.

The Sandgate U.D.C. has refused to agree to the application of the Sandgate and Hythe Electric Co. for powers to construct and maintain tramways in the district.

The New Romney T.C., on the other hand, has decided to support the scheme of the Sandgate and Hythe Electric Co., which will deposit £500, and indemnify the Council against any expenses incurred in the matter.

India.—It is reported that the Bombay, Baroda and Central India Railway, after exhaustive trials made with various systems of electric train lighting, has decided to equip a complete local train with lights and fans on the Vickers-Hall system. It is stated that the new system of Messrs. Vickers, Sons & Maxim for train lighting by electricity is gaining favour in India. The East India Railway Co. has decided to use this system for the Lieut.-Governor of Bengal's saloons.

London.—Metropolitan District Railway.—Reporting to the B. of T. on the collision between two electric trains, which occurred at Mill Hill Park Junction on November 7th last, Major J. W. Pringle says that he believes the automatic signal was at danger, but was not seen by the driver of the Ealing train. The brake trigger of the latter, therefore, ought to have engaged with the train stop; the Inspector thinks that it must have been twisted, and suggests that the apparatus requires improvement.

On Monday last fire broke out on one of the Inner Circle trains, and caused a delay of traffic for a quarter of an hour. The fire was extinguished in Westminster Bridge Station, and the damage was not serious.

Thanks to the completion of the new signalling arrangements as far as Mansion House, a greatly increased service of trains between the West End and the City commenced yesterday. Additional trains are also running to and from Hounslow, Acton, Turnham Green, Hammersmith, and Earl's Court.

Harrow Road and Paddington.—The B. of T. has approved of the plans submitted by the Harrow Road and Paddington Tramways Co. for the reconstruction of their tramways in Harrow Road.

Wandsworth.—With regard to the Borough Council's appeal relating to certain L.C.C. tramway feeder pillars, the B. of T. has decided to appoint Mr. A. P. Trotter, its electrical adviser, to visit the places in question and confer with the parties with the view of finding a satisfactory settlement.

Battersea.—Work was commenced on Saturday in Falcon Road in connection with the electrification of the horse tramways.

L.C.C.—With regard to the Tramways and Improvements Bill, which seeks power to construct electric tramways from the Marble Arch along Edgware Road to Cricklewood, the borough Council has been advised by its General Purposes Committee to petition against the Bill.

Lowestoft.—At a meeting of the T.C. on Tuesday, it was announced by the Tramways Committee that the working of the Corporation tramways had resulted in a deficit for the past financial year of £1,276. It was necessary, accordingly, to advance the fares in some cases, and new fares were recommended by the Committee. By this means it was expected that the revenue would be increased by £2,000 per annum. The course proposed by the Committee was approved.

Mossley.—The T.C. has been informed that the electric tramway scheme between Oldham, Mossley and Saddleworth has been abandoned.

Oxford.—A statutory meeting of the ratepayers has refused, by a large majority, to approve of the Oxford Tramways Bill.

Pembroke (Ireland).—The Dublin United Tramways Co. has refused to pay the cost of widening and improving Ballsbridge, regarding the claim of the U.D.C. (£8,414) as extravagant, and offering £3,000 in full settlement. The Council will take proceedings to enforce its claim.

Stalybridge.—A tramcar running between Hyde and Stalybridge, in the service of the Joint Tramways Board, when at the top of Dukinfield Brow, got out of control and ran away for nearly half a mile, dashing aside many vehicles. The passengers in the car had marvellous escapes; all jumped off, and four were injured by the fall. The tram was eventually stopped by contact with a lorry load of bricks. The cause of the accident was skidding, owing to the greasy nature of the rails. The driver, named Short, pluckily stuck to his post.

Todmorden.—At a public meeting of the burgesses on the 11th inst., the Corporation was authorised immediately to promote a Bill in Parliament to provide and run motor-omnibuses within and without the borough in connection with the tramway systems of the Corporations of Halifax, Rochdale and Burnley. This will supply the missing link of a complete service of cars or 'buses connecting Lancashire and Yorkshire, and extending from Bradford and Leeds to Manchester, Liverpool and Blackburn.

Traffic Returns.—The following figures show the total traffic returns for the year ended December, 1905:—

Chatham and District ..	£34,171	Increase on 1904 ..	£3,693
Cork	£25,099	Increase on 1904 ..	£694
Dublin	£132,834	Decrease on 1904 ..	£16
Lanarkshire	£39,720	Increase on 1904 ..	£5,725

Wishaw.—A resident has been awarded a verdict for £500 damages against the Lanarkshire Tramways Co. for injuries received through a blow on the head from the trolley pole, when he was travelling on one of the company's cars.

TELEGRAPH AND TELEPHONE NOTES.

Manchuria.—The Great Northern Telegraph Co. officially announces the repair of one of the Nagasaki-Vladivostock cables, thus again opening for public use cables which were closed during the Russia-Japan War.

The Port Arthur-Chifu cables now only remain closed.

The Russian Administration announces that at Vladivostock communication is now maintained between that place and Siberian towns as far as Blagowestschensk and the Manchurian border towns.

New York City.—During 1905 there has been a net gain of over 35,000 instruments operated by the New York Telephone Co. in Manhattan and the Bronx, which make up the chief part of the Greater City.

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 18, 1902	
Closed { Vladivostock-Nagasaki	Feb. 7, 1904	Jan. 15
Closed { Port Arthur-Chifu	Mar. 7, 1904	
Jamaica-Colon	Jan. 5, 1905	
Cadiz-Tenerif	July 20, 1905	
Tarifa-Tangier	Jan. 18, 1904	
Puerto Plata-Martinique	Oct. 30, 1905	
St. Thomas-St. Kitts	Dec. 28, 1905	
Manila-Iloilo	Dec. 28, 1905	
LANDLINES.		
Puerto-Barrios	Aug. 28, 1902	
Kertch-Soutehoum	Sept. 27, 1904	
Communication with Brazil *via* Galveston	July 18, 1905	

Venezuela.—The French cable dispute is summarised in the *Morning Post* of the 12th inst., which publishes a leader on the dispute between France and Venezuela, and states therein that the quarrel over the cable company was at first considered likely to lead to serious developments. In September it was hoped that "the Cabinets of Paris and Washington . . . . . having almost similar grievances against Venezuela, might be able to agree on joint action against that country." The French Naval Demonstration threatened for October failed to materialise. According to a Paris telegram, however, "it is believed that a French force would be landed, with the full consent of the American Government. President Castro, though only a few weeks ago he stopped official messages from the British, French, and United States Missions to their respective Governments, because of alleged incivility on the part of the cable company, and although he still refuses an actual apology to France for his summary treatment of her representative, is at the same time willing to come to terms with the company. Meanwhile he justifies his whole attitude on the ground that the annulling of the concession of the company was not by an arbitrary act of the executive, but by a judicial decree of the Court of Cassation of Venezuela. This, says the *Morning Post*, is a bold plea and well taken, for it is easier to contradict than to controvert, and those who are most doubtful of its honesty may yet find it difficult to disprove.

An official notice was issued on the 12th that the Government of Venezuela had interrupted the telegraphic service by the French company's cable, and that in consequence that country was cut off from the world's telegraphic system. Diplomatic negotiations are now broken off.

Wireless Telegraphy.—Mr. Monckton's report, published in a contemporary, on the trials by him of Dr. Muirhead's system of wireless telegraphy between Trinidad and Tobago, a distance of 30 to 50 miles, is very interesting, but we think it does not give information upon one or two important matters which might have been given. The traffic between the two places must be, of course, almost a negligible quantity, but it is necessary that the communication, to be of most use, should be constant, and we should like to know what is meant by "satisfactory communication." Is it available at all times—night and day—at a fair speed? Are messages passed without undue delay as with cables? It would also be very interesting to know the cost to the Trinidad Government and all concerned, of the installation at Scarborough, Tobago and Port-of-Spain, Trinidad, including that of the landlines, &c., from the wireless station to offices, and the annual charge to be incurred for maintenance from end to end, including landline connections. We shall then have before us information of commercial value which our readers may desire, as well as the results of experiments already fairly well known to most of those interested in the advancement of wireless telegraphy.

Gen. A. W. Greeley, of the U.S. army, states that new devices invented by officers of the U.S. Signal Corps will enable the War Department to read any wireless message sent by any of the existing systems. The U.S. Navy Department at present uses regularly the Fessenden, Arco-Slaby and De Forest systems, and the new apparatus makes intercommunication between these possible. On December 19th a wireless message was sent by the Government service between New York and Pensacola, a distance of 2,150 miles, a mileage greater than that between the cable terminals in Newfoundland and Ireland.

The British Admiralty has given orders for wireless telegraphy to be installed in the cruisers attached to the gunnery school ships and in the vessels forming the Particular Service Squadron.

The *Indian and Eastern Engineer* reports that following the employment of wireless telegraphy between India and the Andamans, the Telegraph Department is now prepared to transmit messages to incoming and outgoing ships *viâ* the Sandheads.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—January 22nd. Cast-iron disk fly-wheel for Willans engine, for the Electricity Committee. See "Official Notices" January 12th.

Barnes.—February 12th. Steam dynamo and switchboard panels for the U.D.C. See "Official Notices" to-day.

Battersea.—February 5th. One 750-850 or 1,000-KW. generator with piping and ejector condenser; arc lamps, globes and columns, for the B.C. See "Official Notices" January 12th.

France.—January 30th. The municipal authorities of Briancon are inviting tenders until the 30th inst. for the electric lighting of the Mont Dauphin military establishments in that town. Particulars may be obtained from, and tenders are to be sent to, La Mairie de Briancon (Hautes Alpes).

Fulham.—January 31st. Steam, water and exhaust piping for the electricity department. See "Official Notices" January 12th.

Hammersmith.—February 7th. General stores for the B.C. electricity department for one year. See "Official Notices" to-day.

Kingston-upon-Hull.—February 12th. Air space telephone cable and extension of existing multiple switchboard for the Corporation telephone equipment. See "Official Notices" to-day.

Plymouth.—January 24th. Stores for the Corporation electricity department.

Pontypridd.—February 13th. One 300-KW. steam dynamo for the U.D.C. See "Official Notices" to-day.

Southend-on-Sea.—January 25th. One 500-KW. steam dynamo for the Corporation. See "Official Notices" December 22nd.

Spain.—January 30th. The Spanish Ministerio de Fornento in Madrid is inviting tenders until the 30th inst. for the concession for the construction and working of an electric tramway between Santander and Ashllero. Particulars may be obtained from, and tenders are to be sent to, El Ministerio de Fornento, Madrid.

Stoke-upon-Trent.—January 31st. Meters and demand indicators for a year. See "Official Notices" January 12th.

CLOSED.

Bristol.—The Governors of the Bristol Royal Infirmary have recently decided to introduce a complete system of telephonic communication throughout their institution, and to connect same with the Nurses' Home in Terrell Street. They have accepted the tender of a local firm of electrical engineers, Messrs. Rouch and Penny.

Croydon.—The Lighting and Electricity Committee recently recommended that the tender of Messrs. Dick, Kerr and Co. for a 1,000-KW. D.C. generator, at £6,975, be accepted.

East Ham.—The T.C. received on Tuesday six tenders for storm water and sewage pumping plant, and accepted that of Messrs. Allen Son & Co. for a combination of direct steam driven and electric driven plant.

Gravesend.—The T.C. has accepted the tender, at £1,678, of Mr. W. E. Thomas, for additions to the engine house of the generating station.

Leyton.—The U.D.C. has received the following tenders for the construction of the permanent way of the new electric tramways:—

T. Adams	£155,051	Geo. Law	£148,677
G. J. Anderson	138,144	W. Manders	127,486
R. W. Blackwell & Co.	138,862	F. Osman	165,948
R. C. Brebner & Co.	172,532	Playfair & Toole	167,976
J. & W. S. Briscoe	152,245	Pethick Bros.	151,170
British Electric Equipment Co.	125,477	Smith & Co.	159,186
Dick, Kerr & Co.	140,541	Smith & Co.	168,795
J. Ewart	158,658	T. Cook Starkey	127,343
A. Fasey & Co.	154,823	Geo. Trentham	166,678
W. Griffiths & Co.	132,906	Underwood Bros.	135,163
Geo. Hay & Co.	132,838	J. G. White & Co.	143,673
D. T. Jackson	150,735	G. Wimpey & Co.	146,174
A. Krauss & Son	146,704	W. Wise & Co.	157,554
		C. A. Zadig & Co.	114,764

The Council will consider the tenders in Committee.

London.—BERMONDSEY.—The Council received the following tenders for the supply and erection of a steam dynamo:—

British Thomson-Houston Co., £3,129, £3,450, £3,838, £3,570, £3,348, £3,497.
British Westinghouse Co., £3,766, £4,046, £3,696, £3,764 10s., £3,445.
Bruce Peebles, £3,333, £3,667, £3,412.
Brush Electrical Engineering Co. (accepted), £2,695.
Crompton & Co., £3,356, £3,522, £3,867, £3,528, £3,434, £3,474.
Browett, Lindley & Co., £3,190, £3,253, £3,369, £3,302, £3,297, £3,273, £3,196.
Dick, Kerr & Co., £3,150, £3,434, £3,585, £3,272, £3,482.
Vickers-Maxim, £3,158.
Electrical Co., £3,844.
Electric Construction Co., £3,178, £3,439, £3,478, £3,572, £3,872.
Fairbarn & Lawson, £4,240.
Fowler & Co., £3,008, £3,147 10s.
General Electric Co., £3,646 10s., £3,930 10s., £3,525, £3,212 15s.
Howden & Co., £3,346.
Mather & Platt, £3,410, £3,555, £3,455.
Parsons & Co., £3,476.
Phœnix Dynamo Co., £3,074, £2,820, £3,164, £3,474.
Thomas Parker & Co., £3,386, £3,290, £3,534, £3,685.
British Electric Plant Co., £3,190, £3,310, £3,284, £3,399, £3,400, £3,655.
Siemens Bros. & Co., £3,045, £3,088, £3,219, £2,586, £2,915, £3,739 10s.

The following tenders were sent in after date:—

Johnson & Phillips, Ltd., £3,174, £2,490, £3,360, £3,460, £3,610, £3,505.
Industrial Engineering Co., £3,400.

The electrical engineer's estimate (including concrete foundations) was £3,540.

The Committee reported the receipt of a letter from the Brush Electrical Engineering Co. to the effect that they would guarantee the steam consumption of their engines not to exceed that specified in their tender at the end of twelve months from the date of starting. The engines of this type, several of which had been running for upwards of three years, had given such satisfactory results in this respect that they had not the slightest hesitation in giving this guarantee. On the strength of this letter the Committee recommended that the tender of the Brush Co., at the sum of £2,695, be accepted, subject to 10 per cent. of the money being retained until the electrical engineer had certified that the engine was in every way satisfactory at the end of twelve months' working. This was agreed to.

The B.C. received the following tenders for the supply and erection of a boiler in connection with the electricity works:—

Babcock & Wilcox, Ltd., (accepted at £1,500), £1,500, £1,650, £1,080.
Davies Patent Boiler Co., £1,791.
Clarke, Chapman & Co., £1,993.
Rowland & Co., £1,589.
Stirling Boiler Co., £1,567.
Willans & Robinson, Ltd., £1,675.

The electrical engineer's estimate was £1,850.

MARYLEBONE.—The B.C. has extended the contract of Messrs. William Cory & Son, Ltd., to supply coal to the generating station to the end of March next at prices ranging from 12s. to 12s. 6d. per ton.

The Council has received the following tenders for the purchase of 40 tons of old high-tension rubber cable:—

Messrs. J. Levy & Son (accepted) £41 10s. per ton.
" P. Huddleston & Co., £36 12s. per ton.
" A. Brown & Sons, £35 per ton.

Rochester.—The T.C. has approved of the acceptance by the Chatham Light Railways Co. of the tender of Messrs. Dick, Kerr & Co., Ltd., with the British Thomson-Houston Co. as sub-contractors, for the extension of the tramway from Star Hill to Dilce Grange.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued:—

Monday, January 22nd.—"A" Company, technical instruction, 7 p.m.; recruits' drill, 6 p.m.
Tuesday, January 23rd.—"B" Company, recruits' drill, 6 p.m.; technical instruction, 7 p.m.
Wednesday, January 24th.—"A" badge examination.
Thursday, January 25th.—"C" Company, recruits' drill, 6 p.m.; technical instruction, 7 p.m.
Friday, January 26th.—"D" Company, recruits drill, 6 p.m.; technical instruction, 7 p.m.
Saturday, January 27th.—Week-end whole day instruction for country members of "A" Company.

H. F. BIGGE, Captain E.E.
For O.C.E.E.R.E. (V).

FORTHCOMING EVENTS.

To-day's Events (Friday, January 19th).—At 8 p.m. I.M.E. Meeting. Mr. R. A. Bruce on "Worm Contact."
At 9 p.m. Royal Institution. Prof. J. J. Thomson on "Some Applications of the Theory of Electric Discharge to Spectroscopy."
N.E. Coast Institution of Engineers and Shipbuilders. Meeting.
At the Hotel Cecil. Electrical Engineers' Ball.

Saturday, January 20th.—At 7.30. Glasgow and West of Scotland Technical College Scientific Society. Mr. J. Hogg on "Deep Mine Pumping."
At 10 a.m. I.E.E. (Students). Visit to Silvertown Telegraph Works.
Thursday, January 25th.—At 8 p.m. I.E.E. "Technical Considerations in Electric Railway Engineering," by Mr. F. W. Carter.
At 8 p.m. Society of Arts. Prof. S. P. Thompson on "High Speed Electric Machinery." (Howard Lecture II.—"Turbo-Dynamos.")
Friday, January 26th.—At 8 p.m. Physical Society. Meeting.
At 7.30 p.m. I.E.E. (Manchester Students). Mr. F. Shaw on "Electric Lamps."
At 8 p.m. Junior I.E. Prof. J. D. Cormack on "Notes on Boiler Trials."
At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders. Meeting at Newcastle.
At 8 p.m. Electro-Harmonic Smoking Concert. (See "Notes.")
Saturday, January 27th.—At 3 p.m. Junior I.E. Visit to the Engineering Laboratories of University College. Demonstration of methods of conducting a Boiler Trial, by Prof. Cormack.
At 7.30 p.m. Glasgow Technical College Scientific Society. Mr. J. Andrews on "Cylinder Ratios."
Tuesday, January 30th.—At 7.30 p.m. I.E.E. (Manchester). Mr. J. Atkinson on "Gas Engines applied to Electric Driving."
Thursday, February 1st.—At 8 p.m. Society of Arts. Prof. S. P. Thompson on "High Speed Electric Machinery." (Howard Lecture III.)
Rugby Engineering Society. Mr. C. McCarthy-Jones on "The Transmission of Electrical Energy."
At 8 p.m. Civil and Mechanical Engineers' Society. Mr. F. L. Watson on "Destructor Bye-Products."
Friday, February 2nd.—At 9 p.m. Royal Institution. Prof. S. P. Thompson on "The Electric Production of Nitrates from the Atmosphere."

NOTES.

Electro-Chemical Factory. — *Das Handels Museum* (Vienna), of January 4th, reports that a company has recently been founded in Christiania, with a capital of 7,000,000 kronen, for the purpose of erecting a factory for the production of saltpetre by the electro-chemical methods laid down by Dr. Birkeland and Engineer Eyde. The capital is chiefly French, partly German, and partly Scandinavian. Engineer Eyde has agreed to act as general director of the concern for a period of ten years. The other members of the directorate are well-known capitalists from Norway, Sweden and Paris. Prof. Birkeland and other leading scientists and engineers will assist the company as technical advisers. The factory is to be erected at Notodden (in Thelemarken), where an experimental factory has already been built by Eyde. A powerful waterfall, 45 metres high, of the Svälgfos will be used for power production, and, in case of necessity, other falls may be used, so that the 30,000 H.P., with which manufacture will be commenced, can eventually be increased to 300,000 H.P. The Birkeland-Eyde process is, however, only feasible for countries with cheap water power, and the anticipated annual production amounts only to 20,000 tons, or not more than 1 per cent. of the total world's demand of about 1,700,000 tons. But this new production is capable of great development, and may cheapen the product.

A New Microphone.—The Italian technical Press has recently been discussing a new microphone invented by M. Quirino Majorana. *L'Elettricista*, of Rome, has received a note from the inventor on this subject, which reads as follows:—

"Experiments in telephonic transmissions at great distances which I have recently made, have given occasion to the Press for the publication of information, often incomplete, which has given a false impression of the nature and aims of these experiments. . . . .

"Since the discovery of the microphone, the apparatus used up to the present has been based on imperfect contacts of carbon, and the microphones used in commerce are nearly all founded on the use of granulated carbon between two conductors, one of which, at least, is susceptible to vibration.

" . . . . I may remark that the Bailleux microphones used by the telegraph department in Italy, when suitably used, are capable of carrying a current of 20 to 25 milliamperes for a number of vibrations of 500 per second. This result represents the maximum intensity which can be obtained from apparatus of this kind.

"I have recently had occasion to experiment with a new type of microphone which differs completely from those employed at the present time. It is based on the capillary contractions produced by vibrations in a jet of liquid, a subject which has been studied for some time by Chichester Bell. These contractions produce variations of resistance in an electrical circuit, and allow, under favourable circumstances, a current intensity of 100 milliamperes for a number of vibrations of 500 per second. The distinctness of the speech obtained by this new microphone leaves nothing to be desired. . . . .

"This type of microphone . . . . . will be the subject of further experiments; the construction is more complicated than

that of the ordinary microphone, but the exceptional intensity of the current which it allows of is of such a nature as to render it useful in all cases where the intensity of the current with carbon microphones is found to be too feeble."

Electrical Works in Spain.—There are in Spain 1,140 works producing electric current, with a capacity of 99,514 KW. The provinces with the greatest number of these works are the following:—Gerona, 81; Guipuzcoa, 74; Valencia, 62; Navarra, 60; Zaragoza, 59; Vizcaya, 55; Oviedo, 49; and Alicante, 47. The following have the largest supplies:—Madrid, 15,998 KW. with 35 works; Barcelona, 8,082 KW. with 22 works; Guipuzcoa, 8,492 KW.; Vizcaya, 5,869 KW.; and Zaragoza, Oviedo, Navarra, Murcia and Jaen, with more than 3,000 KW. each. There are electrical works in every province in Spain, but those of Zamora, Almeria, Avela and Huesca are only of minor importance. For public illumination in the country, there are in service 119,105 incandescent lamps, with an aggregate of 1,427,498 C.P., and 1,691 arc lamps, with an aggregate of 1,214,475 C.P. For private illumination there are 1,593,402 incandescent lamps of 13,333,763 C.P., and 8,051 arc lamps of 5,305,775 C.P. There are, moreover, 3,293 electric motors with a total of 25,382 H.P. The majority of these motors are in use in the provinces of Barcelona, Guipuzcoa, Vizcaya and Madrid.

Institution and Lecture Notes.—Coventry Engineering Society.—Mr. A. E. Edwards, M.I.M.E., lectured on 12th inst. upon "The Artificial Lighting of Workshops." He urged that shops should always be kept well white-washed, so as to gain the best reflecting surface, and all machinery be painted grey. Globes should be used so as to avoid sharp shadows. Having discussed the various gas systems, and also acetylene, he proceeded to deal with electric lighting. In the first place, he pointed out the importance of a good dynamo, and advised that if a gas engine were used for driving it should have a heavy fly-wheel and outer bearing, and should be run at a high number of revolutions. A fly-wheel on the dynamo was absolutely unnecessary, and he strongly condemned the practice of putting two fly-wheels on different shafts and trying to get a belt to take up the inevitable back-lash. If they had steam boilers at work already, he advocated putting down a steam engine to drive the lighting plant. Whether it would pay a manufacturer to light his works electrically from a plant of his own depended, to a great extent, on the length of time the light was required. It certainly would not pay on an installation of less than 300 lights unless the lighting hours were more than ordinary. With regard to lamps, arc lighting was one of the cheapest forms of lighting large buildings where a general light was required, and he specially recommended inverted arc lamps when a soft, shadowless, pure light was necessary. With this style of lamp a white ceiling or blinds over the lights were absolutely necessary. In some drawing offices with 15 draughtsmen at work, the offices were lighted by three inverted arcs, and the result was almost perfect; the amount of power consumed was 1,500 watts. As to the cost of running an electrical plant, he gave the result of readings, extending over years, of a gas-driven plant which averaged 4·0d. per unit or ·24d. per 16-C.P. lamp per hour, after making due allowance for repairs, and providing a sinking fund. The cost of lighting the same factory by gas would have been ·2d. per gas-light of the same candle-power. This plant consisted only of about 270 lights, and larger plants running over longer hours could be run at considerably less cost.

At a recent meeting of the Aberdeen Association of Civil Engineers, Mr. David Benzie read a paper on "The Aberdeen Electric Cable Subway."

Before the Midland Colliery Managers' Association recently, Mr. Geo. G. L. Preece, of Salford, delivered a lecture at Nottingham on "The Manufacture, Application and Distribution of Electric Cables for Collieries."

Society of Arts.—Yesterday, Thursday, Prof. Silvanus P. Thompson, D.Sc., F.R.S., commenced a course of three lectures on "High-Speed Electric Machinery and Steam-Turbine Machines." The first lecture dealt generally with the problems of electric design as affected by speed and rated output; the second lecture will be devoted to turbo-dynamos; and the third to turbo-alternators.

Association of Engineers-in-Charge.—The second social dance of this Association took place on Saturday last at the St. Bride's Institute, when about 120 members were present, enjoying the fine music rendered by the Hardy Bijou Orchestra. A splendid programme of 18 dances was gone through with much appreciation under the guidance of Mr. H. Ball, as master of the ceremonies.

Electric Shock Fatality.—At Mountain Ash on 5th inst. an inquest was held on the body of J. J. Thomas, who met his death on the previous Tuesday at the Lower Duffryn Colliery through coming in contact with electric wires. Thomas Jones deposed that he was an engineman, and that deceased had gone up to see about a joint in a pipe, near which were the electric wires. John Fred Flanders, electrician at the colliery, said that the wires were not cased, and that the voltage was 3,300, with the result that the least touch of the wires would bring about death. The Coroner, in summing up, said that owing to the great innovation of electric power at collieries, the management should take every precaution to see that the wires were properly protected, as otherwise many deaths would, unquestionably, ensue, which would mean a great impediment to the progress of the industry in the district. Besides, the fact should be brought home clearly to all men engaged in collieries as to the tremendous danger which they would be running in getting into contact in any way with the wires. The deceased had, doubtless, gone to attend to a joint, when he lost his footing and came into contact with the wires. A verdict of "Death from misadventure" was returned.

Electrical Exhibition.—The *Manchester Courier* says that in the School of Appliances at the Manchester School of Technology it is proposed to hold an exhibition, where will be shown the manufactures of local firms as exhibited at the recent Electrical Exhibition held at Olympia.

British Electrical Friendly Society.—The annual dinner of the Potteries Branch was held at Stoke on Wednesday last week. Mr. J. J. Walklate presided.

Electro-Harmonic Concert.—The next smoking concert is to be held at the King's Hall, Holborn Restaurant, on Friday, January 26th, at 8 p.m., with Mr. F. E. Gripper in the chair. The programme includes vocal music by the Westminster Singers, and Messrs. Bertram Mills, Wilfred Kearton, and Dalton Baker. The instrumental music will consist of violoncello solos by Mr. Kenneth Park, and pianoforte solos by Mr. Alfred E. Izard. The miscellaneous items are: Character impersonations by Mr. Reginald North; humorous songs by Mr. Frederick Rome; and humorous sketches by Mr. Barclay Gammon.

Old P. & O. Electrical Engineers.—We are asked to state that a meeting of old Batti-Wallahs, with the object of an annual reunion, will be held at Westinghouse Buildings, Norfolk Street, Strand, at 5 o'clock p.m., on Monday the 29th inst. It is requested that all who have not been communicated with will attend or communicate with E. Sheppard, 20, Bucklersbury, E.C., hon. sec. *pro tem.*

The North-Eastern Counties Electrical Exhibition.—This Exhibition is to be held in the Exhibition Hall, St. Mary's Place, Newcastle-on-Tyne, opening March 24th and closing April 21st, 1906. It is to be under the auspices of the Newcastle-upon-Tyne Electric Supply Co., Ltd., the County of Durham Electrical Power Distribution Co., Ltd., the Newcastle and District Electric Lighting Co., Ltd., the Northern Counties Electricity Supply Co., Ltd., the Sunderland Corporation Electricity Department, the Electrical Contractors' Association (Northern Section) and several northern electrical manufacturers. Its object is the display of the latest developments in electricity (lighting, heating, power, traction, &c.). Popular lectures and demonstrations of applied electricity will be given.

Appointments Vacant.—Two junior demonstrators for University College, Nottingham (£130); switchboard attendant for Stockport (27s. 6d.); shift engineer for Greenock (36s.). See "Official Notices."

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

Central Station Engineers.—The following appointments have been made in the Birmingham Corporation Electric Supply Department:—Resident engineer, Summer Lane Station, Mr. J. P. Kemp, recently representing Sir A. Kennedy on the Mersey Tunnel contract; sub-stations superintendent, Mr. Frank Forrest, recently with the Charing Cross, West End and City Electricity Supply Co.

The Dartford U.D.C. has appointed Mr. J. E. H. Preedy, of Southampton, as mains engineer.

Mr. C. A. Midgley has resigned the position of city electrical engineer at York.

Mr. C. Furness, the Blackpool borough electrical engineer, entertained about thirty of his staff to dinner at Blackpool, on Monday last week, in honour of Mr. A. D. Murdock, who is leaving Blackpool to take up the position of managing engineer to the Corporation of Deptford. Mr. Furness presented Mr. Murdock with a gold curb chain, with gold pendant, as a mark of esteem, from the staff and employés at the Electricity Works. A smoking concert followed.

Tramway Officials.—Mr. Robert Long, chief clerk to the Rochdale Corporation Tramways, has received an appointment as general clerk under the Cheltenham and District Light Railway Co., of which Mr. H. J. McCormick is the manager and engineer.

Mr. James Marshall has resigned his position as chief assistant constructional engineer to the Preston Corporation, whom he has served during the construction of the electric tramway system, having been appointed engineer and surveyor to the Longridge Urban District Council.

Mr. J. A. Gibson, of Southsea, is proceeding to South Africa on Saturday next, 20th inst., in the *Dover Castle*, to complete the electrification of the Kimberley-Beaconsfield tramway.

General.—On Saturday, 13th inst., a company of motor drivers and electricians employed by the Tinsley Park Colliery Co., Ltd., assembled in the repair shop to present to Mr. E.

GRINDROD, electrician, who has recently been married, with an oxidised non-magnetic lever watch. Mr. J. Ensor, manager, made the presentation. Mr. J. W. Wilson, A.M.I.E.E., chief of electrical department, moved a vote of thanks to Mr. Ensor.

The address of Mr. PHILIP DAWE, A.M.I.C.E., consulting engineer, is now 1, Raymond Buildings, Gray's Inn, W.C.

Mr. CHARLES J. HUNT is leaving Messrs. Johnson & Phillips, Ltd., at the end of this month, after being with them just over eight years, to join the staff of Messrs. Bruce Peebles, Ltd., at East Pilton, Edinburgh.

Mr. T. L. BOYDEN, having recently resigned the position of general manager of the Lister Electric Manufacturing Co., in order to take up the management of the "Morganite" Brush and other electrical manufactures of the Morgan Crucible Co. at Battersea Works, was, on Friday evening, 30th ult., the recipient of a presentation by the members of his staff and the employés of the Lister Electric Works, consisting of a valuable complete set of Dickens's works.

Nature says that Dr. R. A. LEHFELDT, Professor of Physics at the East London College, has been appointed to the chair of Physics in the Transvaal Technical Institute, Johannesburg.

Electromotors, Ltd., Openshaw, Manchester, have appointed Mr. J. H. HEADLEY as their London representative in succession to Mr. G. H. CONGDON, who terminated his engagement last month. Mr. Headley has been with the company for some years in the capacity of representative engineer.

The annual "At Home" of the Glasgow Corporation Telephone Department was held on 11th inst. Dancing continued until 2 a.m. Among those present were the Lord Provost, Bailie J. Alexander (convener of the Telephone Committee), Bailie Stevenson (subconvener), and Mr. Macfee, the general manager.

The Glasgow Corporation Electricity Department officials held their annual dinner at the Grosvenor Restaurant on 11th inst. Ex-Bailie Mackenzie proposed "The Corporation of Glasgow," and the Lord Provost replied. Colonel Young proposed "The Electricity Committee," and ex-Bailie Willock replied.

The first social gathering (supper and concert) of the Rotherham Electricity Works staff took place on Thursday last week, Mr. E. Cross, the engineer, presiding.

Obituary.—The *Times* records that on Sunday the death occurred suddenly in London of Dr. HERMANN JOHANN PHILIPP SPRENGEL, the inventor of the mercury air-pump. He was born in 1834 at Schillerslage, near Hanover. He was elected a Fellow of the Royal Society in 1878. His air-pump, which he described to the Chemical Society in 1865, put into the hands of investigators a convenient method, which they had previously lacked, of obtaining vacua of very high tenuity. "Thus, on the one hand, it enabled Sir William Crookes to carry out those experiments which led him to his theory of radiant matter, and of which the discovery of the Röntgen rays was a lineal descendant, while, on the other, it assisted at the birth of the incandescent electric lamp. Sir Joseph Swan's earliest attempts at making a carbon glow lamp were foiled by the impossibility of getting a sufficiently good vacuum; it was the mercury pump which enabled him to overcome this difficulty, and which, since the introduction of the incandescent lamp as a commercial article, has been, in various modifications and improvements, a most important instrument in its manufacture." He had only recently lodged an application for a patent relating to the production of diamonds at high temperatures. The funeral will take place at Brompton Cemetery on Friday.

We have to record the death of Mr. JAMES MCDONALD ANGUS, which occurred on Monday, 15th inst., at Leven Fifeshire, at the age of 65. Since 1897 Mr. Angus has been principally engaged in the construction of tramways, having been a resident engineer for several of those built by the British Electric Traction Co., and he was at the time of his death acting as resident engineer for Mr. Stephen Sellon on the Wemyss and District Tramways. He has also recently been engaged in the valuation of some of the properties of the London Water Companies in connection with their transfer to the Metropolitan Water Board. For the greater part of his career, however, Mr. Angus was a railway engineer. Mr. Angus's death breaks a link with the earliest days of railway enterprise. His personality is one which impressed itself on all with whom he was brought into contact, and the news of his death will be a source of regret to a very large circle of engineers. He continued hale, hearty and in good working condition up to a very few days of his death.

THE CHILD'S GUIDE TO KNOWLEDGE.

The *American Street Railway Journal* gives up considerable space occasionally to "Question Boxes." In a recent issue the whole contents of the "Question Box," which was presented at a meeting ("convention" is the harsher American equivalent) of the Mechanical Association, are scattered over our heads.

Much interesting information is pickable from the mass, but we sympathise with the ardent picker who is so anxious to acquire merit that he will turn over every paragraph. The judicious use of the blue pencil would make the answers yield more gold per ton. Then, again, most of the replies have no more than the value of individual opinion, which, indeed, may be valuable, but cannot be supported by proofs, instances or statements of conditions, because of the malady which editors are fond of calling exigencies of space.

Those who have switchboards which have suffered from the effects of blown fuses, or switches opened under heavy currents, may be glad to add the following to their book of workshop recipes:—

"First clean off with sandpaper; then give one coat of any good filler that will not carry current. When dry, putty up all uneven surfaces, using good hard-drying putty. Rub down with rock pumice-stone, clean off, and give one or two coats of colour, two coats of japan; varnish, dry thoroughly, and polish. A good polish can be made from butter of antimony and raw oil."

The question, "How often should motors be overhauled?" brought out clearly the better value in modern than in ancient tramway motors. "On four-motor G.E. 1,000 equipments, 20-ton cars, 14,000 miles is considered right; while on four-motor G.E. 800 equipments, 16-ton cars, only 9,000 miles can be gotten in the same city." Another answer says:—"G.E.-58-motors should be overhauled every ninety days for inspection and cleaning; W.P. or the 800 class every 30 days."

Those statements, coming from places so far apart as San Francisco and Oregon, are full of meat, and should be of some use to those unfortunate individuals who suffer at the hands of their directors or committee, because they cannot maintain their five-year-old cars at the cost per mile for which someone else is maintaining newer cars with modern equipments.

To those who have followed the articles on four-motor equipments which have appeared in the ELECTRICAL REVIEW, it will be of interest to hear that in San Francisco a 10-ton car equipped with two 1,000 motors is overhauled after 10,000 miles, while the 20-ton 4-motor cars with the same type of motor will run 14,000 safely.

We hear that there are still some people who use grease in their motor bearings. The testimony from America on the folly of this practice is the same as we have given all along. "A motor run in grease should be overhauled every 90 or 100 days; one run in oil, every six months."

The cost of lubricating a four-motor car is put down at anything from 4d. to 1s. 2d. per 1,000 car-miles, and the answers to that question show very well the general futility of the question box scheme. No one can deal adequately and convincingly with the subject of lubrication in less than a column.

Considerable difficulties still present themselves when old-style grease boxes have to be converted into oil-cups. One man has tried "seven different devices with indifferent results," and he has given up the adjustable feed as too uncertain under dirty tramway conditions. He seems to fancy an arrangement with which many of our readers will have been made familiar by the enterprise of a certain firm, who appear to hold patents for some mysterious substance which is said to drop oil in the right quantity at the right time only.

"We fit a piece of wood perfectly tight in the slot at the bottom of the grease cup. . . . We bore a ½-in. hole in the centre, and fit a piece of ⅜-in. felt, previously soaked in oil, in the bottom of the grease cup. We then pack the remaining space with wool waste, packing very tight, and pour in two or three table-spoonsfuls of oil. The first car thus equipped ran 320 miles, and oil could still be pressed out of the waste . . . ."

Two replies were sent in to the question, What difference do you allow between wheel and track gauge? and in both cases they were ¼ in. That agrees with our own practice. The wheel gauge must be measured from the root of the flange.

There is a general agreement that a continuously supported rail should be made high in carbon, while rails supported at intervals should have much less. The Manhattan rails are supported rigidly at 5 ft. intervals, but appear to be high in carbon with the result that they break near the joints. Some doubts have been expressed as to the wisdom of the Standards Committee in setting the lower limit of carbon in tramway rails so low as ·4 per cent., and we see that one of the replies to a question about the right proportion of carbon states that for 17 years the writer has specified ·55 to ·60 per cent., and that "no trouble has been experienced on account of extra liability to break, sufficient to offset the additional life of the rail."

Whenever rails are made so brittle as this high percentage would indicate, the importance of solid joints cannot be over-rated, for any hammering will tend to break the rail.

NEW COMPANIES REGISTERED.

N.A.G. Automobile Co. of Great Britain and Ireland, Ltd. (87,220).—This company was registered on January 13th, with a capital of £5,000 in £1 shares, to carry on the business of automobile store and garage keepers, motor-car and carriage manufacturers and agents, suppliers of electricity and motive power of any description for motor-cars and vehicles, electricians, electrical engineers, generators and storers of electricity, &c. The first subscribers are:—T. L. Spencer, The Homestead, Sevenoaks, engineer, 100 shares; N. R. Spencer, The Homestead, Sevenoaks, clerk, 100 shares; St. J. J. Jeffries, 291, Hither Green Lane, S.E., secretary, 1 share; C. B. Stillwell, Glenthorne, Blythe Vale, Catford, S.E., clerk, 1 share; C. J. Pollard, 25, Fielding Road, Bedford Park, W., clerk, 1 share; H. D. Moor, 16, Aldridge Road Villas, Westbourne Park, W., clerk, 1 share; and E. T. Marler, 41, FitzGeorge Avenue, West Kensington, W., clerk, 1 share. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, one share; remuneration as fixed by the company. Registered office, 11, Gresham House, Old Broad Street, E.C.

Hudson Engineering Co., Ltd. (87,149).—This company was registered on January 8th, with a capital of £5,000 in £1 shares, to carry on in Manchester or elsewhere the business of electrical, mechanical and general engineers, &c. The first subscribers (each with one share) are:—L. C. Anderson, 16, St. James's Terrace, Heywood, secretary; W. H. Taylor, 15, Carnarvon Street, Hollinwood, engineer; R. R. Patterson, Brook Road, Cheadle, engineer; A. E. Sudlow, 35, Balleratt Street, Levenshulme, electrical engineer; J. M. Wallwin, 59, Corporation Street, Manchester, electrical engineer; J. H. Stage,

6, Booth Street, Manchester, chartered accountant; and J. M. Hewitt, 24, Portland Crescent, Manchester, engineer. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company. Registered office, 30, Spring Gardens, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Hosiery and Electrolytic Bleaching Co., Ltd. (Nottingham and London) (86,337).—Particulars of £8,750 debentures, created by resolution of November 15th, 1905, charged on the company's assets, including uncalled capital, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. No trustees.

Mann, Egerton & Co., Ltd. (electrical engineers, Norwich, and elsewhere) (83,780).—Issue on December 21st of £5,000 debentures, part of series created April 1st, 1905, to secure £10,000 charged to various freehold and leasehold properties in Norwich and Ipswich, and the company's undertaking and property, present and future, including uncalled capital. Trustees: G. F. Buxton, Dunston Hall, Norfolk; and J. J. D. Paul, Eaton Grove, Norwich. Previously issued of same series: £4,100.

Cutting Bros., Ltd. (electrical engineers, Derby) (81,178).—Issue on December 16th of £850 6 per cent. debentures, part of series created June 20th, 1904, to secure £4,000 charged on the company's property, present and future, including uncalled capital. Holders: Janetta W. French, Winscales, Workington; Mrs. A. Priest, Heigham Grove, Norwich; and Mrs. H. Northwood, 4, Milton Street, Derby. No trustees. Previously issued of same series: £2,800.

F. E. Baker, Ltd. (mechanical and electrical engineers, Birmingham) (86,786).—£500 debentures, created and dated December 21st, 1905, charged on the company's undertaking and property, present and future, including uncalled and unpaid capital, have been registered. No trustees.

Kuettner, Macdonell & Cookson, Ltd. (electrical engineers, &c., London) (83,946).—A debenture dated September 22nd, 1905, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital, subject to a debenture dated March 28th, 1905, securing £750, has been registered. Holder: B. Cookson, 7, Imber Park Road, Esher, Surrey.

St. Austell and District Electric Lighting and Power Co., Ltd. (66,382).—Issue on December 22nd, of £150 5 per cent. debentures, part of series created June 1st, 1904, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £500.

Lionel Robinson & Co., Ltd. (electrical engineers, Thames Ditton), (78,015).—Particulars of £4,000 debentures, created by resolution of December 21st, 1905, charged on the company's undertaking and property, present and future, including uncalled capital, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. No trustees.

Edmundson's Electricity Corporation, Ltd. (52,013).—An acknowledgment of indebtedness dated December 7th, 1905, securing £30,000 additional debenture stock at 4½ per cent. interest (supplemental to a trust deed dated July 10th, 1899, and five deeds of acknowledgment of indebtedness dated April 27th, 1900, August 1st, 1901, November 14th, 1902, September 28th, 1903, and August 19th, 1904, securing debenture stock not exceeding three-fifths of the company's paid-up capital for the time being) has been registered. Property charged: £13,000 first mortgage debentures in the Winchester Electric Light and Power Co., Ltd.; £15,000 similar debentures in the Wycombe (Borough) Electric Light and Power Co., Ltd.; £20,000 similar debentures in the Salisbury Electric Light and Supply Co., Ltd.; £15,000 similar debentures in the Ventnor Electric Light and Power Co., Ltd.; £10,000 similar debentures in the Bromley (Kent) Electric Light and Power Co., Ltd.; £4,000 similar debentures in the Woolwich District Electric Light Co., Ltd.; £5,000 similar debentures in the Chislehurst Electric Supply Co., Ltd.; £4,000 similar debentures in the Newmarket Electric Light Co., Ltd.; £5,000 similar debentures in the Alderley and Wilmslow Electric Supply Co., Ltd.; and the company's undertaking and other assets, present and future. Trustees: J. Bailey, 102, Eaton Square, S.W., and the Anglo-American Debenture Corporation, Ltd., 75, Walbrook, E.C.. Total debenture stock previously issued: £350,000.

Yorkshire Electric Tramways Construction Syndicate, Ltd. (77,167).—Memorandum of satisfaction in full of debentures dated July 22nd, 1904, and March 24th, 1905, securing £70,000 and £50,000 respectively, have been filed.

General International Wireless Telegraph and Telephone Co., Ltd. (75,277).—A charge on the company's patents and extensions thereof, dated November 28th, 1905, to secure £550, has been registered. Holder: F. W. Corby, 14, Green Dragon Court, St. Andrew's Hill, E.C.

Sunderland District Electric Tramways, Ltd. (79,054).—A charge dated December 29th, 1905, to secure £2,500, has been registered. Property charged: The company's undertaking and property, present and future, subject to a trust deed dated December 8th, 1903, has been registered. Holders: Bruce Peebles & Co., Ltd., East Pilton, Edinburgh.

China and Japan Telephone and Electric Co., Ltd. (17,831).—Issue on December 22nd of £12,000 7 per cent. debentures, part of series created November 28th, 1905, to secure £50,000. Property charged: The company's undertaking and property, present and future. No trustees. No previous issue of same series.

Automatic Electric Co., Ltd., Liverpool (82,897).—A debenture, dated December 19th, 1905, to secure £100, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: W. Jackson, 44, Martin's Lane, Liscard, Cheshire.

North Melbourne Electric Tramways and Lighting Co., Ltd. (85,463).—A trust deed, dated December 15th, 1905, to secure £200,000 debentures, created by resolution of even date, has been registered. Property charged: Certain freehold land at Flemington, parish of Doutta Galla, county of Bourke, a right of carriage-way over a certain road, the power house and buildings in course of construction on the above-mentioned land, and (as a floating security) the company's undertaking and general assets, present and future. Trustees, United States Debenture Corporation, Ltd., Winchester House, Old Broad Street, E.C.

Buenos Ayres Grand National Tramways Co., Ltd. (28,374).—This company's annual return was filed on November 27th, when the entire capital of £625,000 in 50,000 ordinary, 65,000 first preference, and 10,000 second preference shares of £5 each had been taken up. £5 per share has been called up on 40,000 shares, resulting in the receipt of £200,000, and £425,000 is considered as paid on 85,000. A further £930 has been paid on 3,488 forfeited shares. Mortgages and charges: £852,023.

Mono-Rail Construction Co., Ltd. (77,484).—This company's annual return was filed on January 13th, when 3,000 "A" ordinary, 510 first preference, and 2,000 second preference shares had been taken up out of a nominal capital of £70,000 in 3,000 "A" ordinary, 1,000 "B" ordinary, 1,000 first preference, and 2,000 second preference shares of £10 each. £10 per share has been called up on 510 first, and 2,000 preference shares, resulting in the receipt of £25,100. £30,000 is considered as paid on 3,000 "A" ordinary. Mortgage and charges: Nil.

CITY NOTES.

Westminster Electric Supply Corporation.

MR. E. BOULNOIS presided on Monday at a meeting of this company, at which the shareholders approved the Bill introduced into Parliament "to authorise the association of electric supply undertakers in the West of London, and for other purposes."

The CHAIRMAN said that the company drew their bulk supply when required to supplement the other stations from the Central Electric station, but the Central Co. wanted powers to supply, besides the two companies, railways or tramways requiring bulk supply. A combination of all the metropolitan electric supply companies had been found impracticable, therefore a combination of West End companies was proposed, and it was necessary to seek Parliamentary powers for amalgamation or combination for bulk supply purposes. In view of the attacks from big power schemes, they felt that they must not only act on the defensive but also be able to show that they were themselves able to supply in bulk at a low price.

Notting Hill Electric Lighting Co.

AN extraordinary general meeting of this company was held at Winchester House on Tuesday, Sir Wm. Crookes presiding. The meeting gave its approval to the Bill introduced into Parliament, intituled "A Bill to authorise the Association of Electric Supply Undertakers in the West of London, and for other purposes."

Sir WILLIAM, in moving the resolution, explained the measures contained in the Bill, which was referred to in some detail on p. 69 of our last issue.

Prospectus.

Rangoon Electric Tramway and Supply Co., Ltd.—The list opens on Tuesday next, January 23rd, and closes on 25th inst., in an issue at par of £150,000—4½ per cent. first mortgage debenture stock, and 30,000 6 per cent. £5 cumulative preference shares. The nominal share capital is £500,000 (50,000 £5 preference, and 250,000 ordinary £1 shares). Messrs. J. W. Darwood & Co., the vendors, are to transfer to the company the Rangoon steam tramways, and the new concessions they have obtained for electric lighting and traction in Rangoon, in consideration of the allotment of £65,000 fully paid ordinary shares; they will also subscribe and pay for £85,000 ordinary shares, and pay for same in cash at par.

A 2,900-KW. central generating station is to be equipped by the B.T.H. Co. Messrs. Darwood have relaid some of the tramway track, and also laid certain extensions. It is anticipated that the central station and the new tramways will be at work before the end of March, 1907. The total track mileage will be 24 miles (single). The capital expenditure is estimated at £410,000. The Municipal Committee will take a minimum of 824,000 units per annum for street lighting. The prospectus, of which an abridged copy appears in our advertisement pages to-day, enters very exhaustively into the undertakings and the question of estimated profits.

Metropolitan Railway Co.—The directors announce a dividend at the rate of 2¼ per cent. per annum for the past half-year, as against 3 per cent. per annum for the corresponding period, carrying forward £11,500, as against £11,285. The dividend on the surplus lands stock is to be at the rate of 2⅝ per cent. per annum, as compared with 2¾ per cent. per annum, £900 being carried forward, as against £144.

Direct United States Cable Co.—The board has resolved upon the payment of an interim dividend of 3s. 6d. per share, free of income-tax, being at the rate of 3½ per cent. per annum for the quarter ending December 31st, 1905, such dividend to be payable on and after 31st inst., setting aside £10,000 to reserve fund account, and carrying forward a balance of about £5,848.

Dublin United Tramways Co.—The directors recommend a dividend for the half-year ended December 31st, 1905, at the rate of 6 per cent. per annum on the ordinary shares, after setting aside £4,000 to reserve fund, £1,000 to accident insurance fund, £2,500 towards maintenance in the current half-year, and carrying forward £7,107.

Stock Exchange Notices. — Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—

Commercial Cable Co.—Further issue of £164,824 sterling 500-year 4 per cent. debenture stock (redeemable).

White (J. G.) & Co., Ltd.—15,000 6 per cent. cumulative preference shares of £10 each, fully paid. (Renewed application.)

Western Union Telegraph Co.—The net revenue for the quarter ended September 30th last was $2,007,593, and after paying the usual 1¼ per cent. dividends, &c., and allowing for traffic to December, it is expected the surplus will be $16,785,160 at December 31st last.

Eastern Telegraph Co.—For the six months ended September 30th the revenue amounted to £607,703, leaving a total available balance of £377,603. The directors have placed £10,000 to the reserve fund for maintenance ships, £140,000 to the general reserve fund, and allocated £100,000 to meet the two interim dividends of 1¼ per cent. each on the ordinary stock, £39,471 being carried forward.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	*
Aberdeen	Jan. 6	2,954	+ 62	32	45,363	— 1,124	..	..
Ayr	,, 13	407	— 8	35	11,119	— 109	8	..
Bath	,, 10	1,303	+ 147	2	1,303	+ 147	13	..
Birkenhead	,, 14	2,045	+ 7	41	42,831	— 645	13·5	..
Blackburn	,, 10	1,765	+ 159	41½	40,607	+ 1,841	13·75	..
Blackpool Corp.	,, 11	657	— 10	41	46,013	+ 1,872	11·87	..
,, —Fleetw'd	,, 13	323	— 25	2	323	— 25	..	..
,, —Lytham	,, 11	279	+ 21	10	1,532	+ 164	7½	..
Bolton	,, 14	4,126	+ 384	42	80,892	+ 3,736	26	+ 1
Bournemouth	,, 10	2,740	+ 861	40½	58,308	+12,835	17·4	+ 7½
†Bradford	,, 6	3,889	— 132	40	176,490	— 4,619	53	..
Brighton	,, 14	1,593	+ 43	42	42,361	..	9·5	..
Bristol	,, 12	9,404	+ 161	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	Jan. 5	516	+ 36	52	10,837	+ 334	8·5	..
Barnsley	,, 5	372	+ 15	,,	8,459	— 286	3	..
Barrow	,, 5	433	+ 51	,,	12,479	+ 2,322	5·37	..
‡Birmingham (City)	,, 5	10,825	+ 336	,,	280,173	— 198	14·5	..
Birmingham (Mid.)	,, 5	2,842	— 938	,,	81,747	— 1,176	12·25	..
Devonport	,, 5	918	— 117	,,	23,850	— 3,530	8·85	..
Dudley—Sto'rb'ge	,, 5	1,642	+ 60	,,	46,449	+ 1,805	21·25	..
Gateshead	,, 5	2,135	+ 181	,,	48,581	+ 1,407	11·25	..
Gravesend, N'fleet	,, 5	459	+ 26	,,	12,027	— 799	6·5	..
Gr'n'k, Pt. Glsgw	,, 5	1,289	+ 132	,,	33,575	+ 3,906	7·25	..
Hartlepool	,, 5	582	+ 16	,,	13,944	— 1,115	6·72	..
Kidderminster	,, 5	232	+ 1	,,	6,250	— 333	4·5	..
Leamington	,, 5	300	+ 100	24	4,340	+ 1,580	..	..
Merthyr	,, 5	445	+ 5	52	9,927	— 499	2·9	..
Metropolitan	,, 5	6,288	+2,066	,,	140,130	+58,595	..	..
Middleton	,, 5	642	+ 90	,,	17,536	+ 956	8·5	..
Oldham — Ashton	,, 5	1,150	+ 134	,,	29,237	+ 1,123	9·13	..
Peterborough	,, 5	260	+ 9	,,	6,964	— 665	5·31	..
Potteries	,, 5	3,781	+ 265	,,	90,270	+ 1,721	29	..
Rothesay	,, 5	149	+ 29	,,	9,682	+ 2,719	2·75	..
Sheerness	,, 3	113	— 12	,,	3,576	+ 248	2·5	..
Southport	,, 5	478	— 13	,,	15,869	— 541	8·17	..
South Staffs.	,, 5	1,735	+ 263	,,	39,197	+ 2,445	13·87	..
Swansea	,, 5	1,758	+ 634	,,	38,152	+10,212	5·5	..
Taunton	,, 5	117	+ 6	,,	2,222	— 224	1·5	..
Tynemouth	,, 5	384	— 2	,,	13,165	— 1,552	3·75	..
Weston-s-Mare	,, 3	62	+ 2	,,	6,880	+ 601	3	..
Wolverhampton D.	,, 5	883	+ 57	,,	20,796	+ 568	14·75	..
‡Worcester	,, 5	558	— 43	,,	15,578	+ 326	5·75	..
Wrexham	,, 5	225	— 1	,,	5,260	— 342	4	..
Yorks. Wool. Dist.	,, 5	1,961	+ 737	,,	35,892	+ 5,806	17	..
Burnley	Jan. 13	2,300	+ 216	..	..	..	7·5	..
Burton-on-Trent	,, 14	558	— 43	43	12,833	— 1,492	8·5	..
Bury	,, 7	1,786	..	40	30,291	..	10·5	..
Cardiff	,, 6	3,853	— 199	40	82,461	— 171	15·8	..
Carlisle	,, 13	337	— 4	2	337	— 4	..	..
Chatham and Dist.	,, 11	965	— 31	2	965	— 31	9·33	+ ·8
†Colchester	,, 10	155	— 15	24	4,551	..	7	..
Cork	,, 11	700	— 14	2	700	— 14	9·89	..
Coventry	Dec. 14	815	+ 8	50	23,960	+ 642	9·89	..
Darlington	Jan. 13	382	+ 28	41	8,409	..	4·87	..
Darwen	,, 12	481	+ 48	41	10,031	+ 549	4·36	..
Dover	,, 13	392	+ 42	41	9,400	..	4·75	+ 1½
Dublin	,, 12	8,221	+ 397	2	8,221	+ 397	48·5	+ 1·5
Dundee	,, 10	2,339	+ 295	34	32,039	+ 2,317	12·5	..
East Ham	,, 13	1,598	+ 358	41	34,146	+ 4,516	8	+ 1½
Glasgow	,, 13	33,078	+2,681	32	502,046	+30,952	76	+ 3·5
Gloucester	,, 10	470	+ 9	41	12,110	..	15	..
Halifax	,, 10	2,626	+ 178	41	64,901	+ 4,467	37	+ 2·5
Huddersfield	,, 13	2,667	+ 247	41	56,243	+ 2,838	28	..
Hull	,, 13	4,546	+ 320	41	91,930	+ 1,368	13	..
Ilford	,, 14	809	+ 96	41	19,495	+ 730	..	..
Ilkeston	,, 10	207	+ 14	41	4,871	— 738	3·5	..
Ipswich	,, 13	680	+ 9	41	17,869	— 1,856	10·5	..
Isle of Thanet	,, 13	464	+ 13	2	464	+ 13	..	..
Kirkcaldy	,, 10	529	— 18	..	..	..	7·5	..
Lan'kshire Trm. Co.	,, 11	1,706	+ 324	2	1,706	+ 324	12·5	+ 3·9
Leeds	,, 6	11,560	+ 519	40	242,604	— 6,921	89·5	+ 8
Leicester	,, 13	4,121	+ 662	2	3,841	+ 688	..	..
†Liverpool	Dec. 30	10,469	+ 92	52	550,122	+ 9,206	104	+ 1
L.C.C.	,, 30	29,068	+4,905	39	578,300	+79,412	51	+ 4½
Lowestoft	Jan. 13	288	+ 15	15	2,235	— 23	3·5	..
Manchester	,, 13	24,883	+1,329	41	530,461	+25,833	..	..
Newcastle	,, 6	7,731	+ 197	40	153,057	+ 3,971	..	..
†Newport	,, 6	563	+ 33	14	7,674	+ 524	14·5	+ 1·5
Oldham	,, 14	3,201	+ 483	42	68,924	+16,714	23·75	+ 1·6
Plymouth	..	..	..	..	..	..	..	..
Pontypridd	,, 13	283	..	41	6,656	..	3·5	..
Portsmouth	,, 13	3,117	+ 137	41	81,778	+ 1,361	14·5	..
Preston	,, 10	1,199	..	..	..	..	..	..
†Reading	Dec. 7	556	+ 14	36	23,006	— 484	..	..
Rochdale	Jan. 13	1,644	+ 831	41	32,268	+22,003	21·3	+ 5·8
Salford	,, 8	8,513	+ 428	41	175,453	+10,182	..	..
†Scarborough	Nov. 25	49	..	46	7,735	..	4·5	..
Sheffield	Jan. 14	9,737	+ 820	42	207,952	+11,409	35·75	-1·5
Southampton	,, 10	1,806	+ 79	14	12,705	— 228	..	..
Southend-on-Sea	,, 10	464	+ 21	41	15,689	+ 831	6	..
Stalyb'dge, Hyde, &c.	,, 6	1,229	+ 316	40	25,809	..	21	..
Stockport	,, 5	1,645	+ 738	40	30,580	+ 8,003	15·5	+ 4
Sunderland	,, 14	2,548	+ 235	41	54,820	+ 2,232	..	..
†Swindon	,, 3	165	— 12	40	7,895	..	4·4	..
Tyneside	Dec. 27	754	+ 57	52	21,198	+ 1,182	8·87	..
Warrington	,, 21	665	+ 55	38	12,963	+ 731	6·37	+ ·25
West Ham	Jan. 11	3,918	+1,732	40	75,010	+32,091	14·7	+ 4·9
Wolverhampton	,, 10	1,519	..	..	..	..	10	..
Cen. London Rly.	Jan. 13	13,995	— 382	2	13,995	— 382	6	..
City & S. Lon. Rly.	,, 14	6,173	— 68	2	6,173	— 68	6·25	..
Dublin-Lucan Rly.	,, 12	159	— 27	2	159	— 27	7	..
G. N. and City Rly.	,, 13	3,633	+ 85	2	3,633	+ 85	3·5	..
L'pool Overh'd Rly.	,, 14	2,860	— 125	2	2,860	— 125	6·65	..
Mersey Railway	,, 13	3,502	+ 141	2	3,502	+ 141	4·5	..
Metropolitan Rly.	,, 14	34,697	— 43	2	34,697	— 43	70·5	
Met. District Rly.	,, 14	16,397	+1,130	2	16,397	+ 1,130	24	
†Anglo-Argentine	Jan. 14	14,424	+ 901	..	30,093	+ 2,200	..	..
†Bu'n's A'r's E.T. Co.	Dec. 16	1,176	..	..	59,701	..	..	..
†Perth (W.A.)	Jan. 12	1,602	+ 135	2	2,758	+ 80	24·25	+ 5½

* Compared with the corresponding period of 1904. † One week only.

‡ Includes horse steam and other receipts.

STOCKS AND SHARES.

Wednesday afternoon.

Stock Exchange business is somewhat upset by the General Election this week, and the sweeping Liberal victories are not greatly relished in the markets, so generally Conservative. The effect of the triumphant progress of Radicalism may be traced in the list of falls that has occurred in the Electricity Supply section. Telegraph descriptions make further advances upon the path of improvement, and the Railway department is a trifle better.

Various schemes put forward by the metropolitan supply companies, whereby the consumer of current shall benefit by production of cheap power, are impotent to check the weakness of electricity shares. Last week the fall seemed to have been stayed, and the market gave indications of hardening again. But since then the London constituencies have returned members to Parliament who may, the market fears, be perfectly willing to support the London County Council's Power Bill. Therefore there are falls in Brompton and Kensington Preference, Edmundson's Ordinary and Preference (by way of sympathy), both classes of Westminster and St. James's shares, and in Notting Hill and Metropolitan Ordinary. Nor is this decline considered likely to prove the sum total of the damage. The shares are talked lower, and the market is exceedingly dull. One newly-elected member of Parliament we know, who, upon winning a seat from a London Unionist, sold his electric lighting shares on the day following his achievement. Even Chelseas, which went up ¼, quickly lost the fraction. Westminster Preference ninths are 12s. middle.

Its declaration of a dividend at the rate of 2¼ per cent. per annum by the Metropolitan Railway came as an unpleasant surprise to the market, where 2½ to 2¾ per cent. had been anticipated. This time last year it was at the rate of 3 per cent., and the present announcement gives the stock no more than 2⅜ per cent. for the full year, 1905. Such is the preliminary result of electrification. Half-years to come will, naturally, be worked under very much more favourable conditions, and with this in mind the dealers kept the price of the stock fairly steady at 87½. Districts are 37¼. City and South London keeps at 45, the announcement that the Right Hon. C. B. Stuart-Wortley has accepted the chairmanship of the company making no impression. Central London Preferred rose a point to 104, and the other electric railway stocks are merely firm.

Telegraph issues remain in demand, and the rises go steadily forward amongst the pre-Ordinary stocks. Of the Ordinary shares, Direct United States and Great Northern are each 10s. better, Western Telegraphs ¼, and both the Globe Telegraph shares hardened 2s. 6d., while Submarine Cable Certificates put on a point. On the other hand, Anglo-American Deferred fell upon bull closing prior to the dividend declaration, the Preferred stock moving 2 per cent. upward. The Eastern group is better, Eastern Ordinary recovering the amount of the dividend, 25s., and Eastern Extensions 2s. 6d., while the 3½ per cent. Preference stock of the former company is nearly 30s. up, allowing for the 17s. 6d. dividend.

National Telephone stocks advance with hardly a halt. The Deferred retains its rise of three points, and the Preferred has gained ½ per cent. at 113. It is expected that the dividend will be announced a fortnight hence. Sir James Fergusson, who lost his seat in Manchester, was Postmaster-General in the Conservative Administration that came to an end in 1892, and it was he who signed the agreement with the National Telephone Co. at that time. Oriental Telephones are up $\frac{7}{16}$, and there is no change to report in other Telephone issues.

In the traction department there is continued firmness, and the Argentine shares are all inclined to improve. Anglo-Argentine Ordinary gained $\frac{1}{16}$, and Belgranos ⅛. Calcutta old and new shares are ¼ up. Underground Electric Notes rose a further ¼ upon the directorial appointments, and British Columbia Electric stocks are harder. The public are keenly alert to the possibilities which good 4 to 5 per cent. stocks offer for advance in capital value, for the securities that rejoice in the sweet simplicity of paying 3 per cent. are regarded with decreasing favour.

Willans & Robinson Ordinary at 2¼ and the Preference at 4¼ have each added the fraction, while Henley's Preference improved to 5⅜. Brush shares are being bought at about 8s., and the First Debenture stock spurted to par.

Telephones in Horticulture.—The Board of Agriculture and Fisheries has addressed a circular letter to fruit growers and horticultural societies, with a view to extending the use of the telephone system in country districts, and asking for information to that end.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years.				Closing Quotations Jan. 10th.	Closing Quotations Jan. 17th.	Business done week ended Jan. 17th, 1906.		Rise + or Fall —
			1902.	1903.	1904.	1905. §			Highest.	Lowest.	
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	98½—101½ xd	98½—101½	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3½— 4¼	3½— 4¼	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	82 — 87 xd	82 — 87	85½	84	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2¾%	29s.§	63 — 65	64 — 66	64½	64½	+1
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5¾ %	58s.§	110 —111	112 —113	112½	110½	+2
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	..	17½— 17¾	17 — 17½	17½	16⅜	— ⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	102 —104	102 —104	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7¼— 8¼	7¼— 8¼xd	..	..	..
1,932,856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	98 —100 xd	98 —100	99½	98½	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 % §	8½— 9	8½— 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 % §	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 % §	3⅜— 3⅝	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 % §	8¼— 8½	8¼— 8½	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½% §	99 —102	99 —102	..	..	..
60,710£	Direct United States Cable	20	3½%	3 %	3½%	3 % §	14 — 15	14½— 15½	15⅛	14⅜	+ ⅛
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	101 —103	99 —101	..	..	—2
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	5 % §	146 —149	146 —149 xd	148	147	..
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½% §	91 — 93	91½— 93½xd	92⅜	91½	+ ⅛
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 % §	106½—108½	107 —109	108½	107	+ ⅛
300,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	6 % §	14½— 15	14½— 15 xd	14⅜	14⅛	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 % §	107 —109	107 —109	107½	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	101 —103	102	..	..
180,887	Globe Telegraph and Trust	£3	..	5½%	5⅝%	5 %	11⅛— 11⅜	11¼— 11½	11⅞	11⅜	+ ⅛
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜— 14¾	14⅝— 14⅞	14¹⅞	14⅛	+ ⅛
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	..	37 — 39	37½— 39½	38	..	+ ½
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101 xd	99 —101	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	5 %	57 — 59	57 — 59	58½	..	..
251,127	Marconi's Wireless Telegraph	1	..	..	..	..	1⅛— 1¼	1⅛— 1¼	25/-	..	..
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	8 %	8 %	4 %	..	⅞— 1	⅞— 1	18/-	..	..
86,492	Do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞— 1	⅞— 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 % §	112 —113	112⅞—113½	114	112	+ ½
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 % §	111 — 112	111 —112	111⅞	111	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 % §	13 — 15	13 — 15	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 % §	11 — 13	11 — 13	12⅛	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 % §	5⅝— 5¾	5⅝— 5⅞	5⅞	5⅝	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98½—100⅛ xd	99 —101	100	99½	+ ⅛
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105 xd	104 —105	104½	104⅜	+1
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¼%	6¼%	6 %	1⅜— 1⅝	1⅜— 1⅞	27/9	25/7½	+ 1/6
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1½— 1⅝	1½— 1⅝	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	..	95 — 97	96 — 98	98	..	+1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %§	7¼— 7⅝	7¼— 7⅝	7⅞	7⅝	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	101 —104 xd	101 —104	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	125—128	126 —129	..	..	+1
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7¼— 7⅝ xd	7¼— 7⅝	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	6⅜— 6¾ xd	6⅜— 6¾	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —112	..	..	..
15,509£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9¼— 10	9¼— 10	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	⅛— ⅜	⅛— ⅜	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Brzs. Sub. Tel.	100	4 %	4 %	4 %	4 %	99½—101½ xd	99½—101½	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14 — 14½	14¼— 14½	14½	14⅜	+ ½
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	100 —102 xd	100 —102	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —104 xd	102 —104	..	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜— ⅝	⅜— ⅝	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8¼— 8⅝	8¼— 8⅝	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6¾— 7⅛	6¾— 7⅛	..	..	..
80,000£	Do. do. 5 % Debs.. Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 —103 xd	100 —103	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	6 %§	8¼— 8⅞	8⅝— 8⅞	8⅝	8⅛	+1/16
260,067	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅝— 6 xd	5⅝— 6	5⅝	..	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	140 —143 xd	140 —143	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	103 —105 xd	104 —106	105	..	+1
800,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	16 %‖	3⅞— 4	3⅞— 4	77/6	..	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅞— 1⅞	1⅞— 1⅞	..	..	..
40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	3/6	5½— 6	5¾— 6	5⅝	5¼	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	3/-	5 — 5¼	5 — 5⅛	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2¾— 3¼	2¼— 2½	60/-	58/9	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	98 —102	98 —102	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	..	120 —123	120 —123	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	..	109 —112	110 —113	112½	111	+1
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	110 —113	108 —111 xd	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105%	103 —105 %	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 —105	100 —103 xd	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	8⅜— 8⅞	8⅜— 8⅞	8¹⅛	8⅞	..
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	10⅜— 11⅛	10⅛— 11⅜	11⅛	10⅛	+ ⅛
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	119 —121	119 —121	120⅛	119½	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	98 —100	98 —100	98⅛	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %§	6½— 7	7 — 7¼	7⅛	7⅛	+ ⅛
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %§	5⅞— 6¼	6 — 6⅛	6⅛	6	+ ¼
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%§	103 —106 xd	103 —106	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	98 —100	98 —100	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅜— 2¼	1⅜— 2¼	43/1½	40/7½	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	78 — 83 xd	77 — 82	..	..	—1
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅞— 1⅛	⅞— 1⅛	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	½— ⅝	½— ⅝	..	..	+ ⅛
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1⅜— 1⅝	1⅜— 1⅝	..	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	96 —100	99 —101	..	..	+2
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84 xd	82 — 84	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	..	3¼— 3⅜	3⅜— 3⅞	76/3	73/9	+ ⅛
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	..	5¾— 6	5⅞— 6	..	..	..
27,500	Do. "B" do. 1 to 27,500	5	..	6 %	6 %	..	5 — 5¼	5 — 5¼	5⅞	5⅛	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	105 —107 xd	105 —107	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	100 —103 xd	101 —104	103	102½	+1
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	7 %§	9¼— 9⅜	9¼— 9⅜	9⅛	..	..
32,610	Do. 105,001to 137,610	5	..	..	..	3d.	8¾— 9 xd	8¾— 9	..	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4 %	4½%	104 —106 xd	105 —107	105¾	105½	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10%	11 — 12	11 — 12	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅝— 5¾xd	5⅝— 5⅞	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	109 —111 xd	108 —110	..	..	—1
491,222	Cape E. Trams., 1 to 491,223	1	..	15 %	10 %	5 %§	⅞— 1⅛	⅞— 1⅛	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	..	1⅛— 1⅜	1⅛— 1⅜	22/6	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,999,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %§	95 — 97	95 — 97	96	95½	..
580,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %§	102 —104	103 —105	103	..	+1
580,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	..	86 — 89	86 — 89	87⅞	87⅜	..
1,480,000	City and South London Railway	Stock	3½%	2¾%	2½%	2 %§	44 — 46	44 — 46	44¼	44	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	2½%	..	2 — 2¼	1⅞— 2⅛	..	..	— ⅛
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98⅝ xd	97	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	§1905.	Closing Quotations Jan. 10th.	Closing Quotations Jan. 17th.	Business done week ended Jan. 17th, 1906. Highest	Lowest.	Rise + or Fall−
52,000	Dick, Kerr & Co., 1 to 52,000	† 5	..	..	10 %	..	8¼ — 9	8¼ — 9	..	..	..
61,000	Do. do. 6 % Cum. Pref., 1 to 61,000	5	..	6 %	6 %	6 %	5½ — 6¼	5½ — 6¼	6¼	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	104 —106 xd	104 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½%	6 %	6 %	13¾— 14½	13¾— 14¼	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14½— 15½	14½— 15½	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½—100½	99⅝—100½	..	..	..
300,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	98 — 99	98 — 99	..	..	..
300,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	96 — 96½	96 — 96½	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½%§	..	1⅝— 1⅞	1⅝— 1⅞	..	..	..
17,189	Do. "A" shares, 01—017,189	5	Nil	Nil	2½%§	..	2¼ — 2⅜	2¼ — 2⅜	51/10½	51/3	..
344,023‡	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88 xd	86 — 88	..	..	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	92 — 97	92 — 97	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅜ — ¾	⅜ — ¾	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	1¼ — 2⅜	1¼ — 2⅜	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	92 — 95	90 — 93 xd	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9 — 9¼ xd	9 — 9¼	9¼	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	96 —100	96 —100	96	94	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %§	5 — 5½	5⅛— 5⅜	5 1/16	5⅛	+ ⅛
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10¾— 11¼	10¾— 11¼	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —103	102 —103	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	10%§	12⅛— 13⅛	12⅛— 13⅛	13⅛	12⅞	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5⅛	+ ⅛
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	.. — ..	.. — ..	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10 %	5 %	2½%§	18 — 19	18⅛— 19½	18⅞	18⅝	+ ½
300,000‡	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1⅝%	1½%	..	1⅞— 2⅛	1⅞— 2⅛	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6½— 7	6½— 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	4 %§	10 — 11	10 — 11	..	..	..
399,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	4 %§	4 — 5	4 — 5	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	9¼— 10 xd	9¼— 10	..	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	98 —101 xd	98 — 101	98⅜	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	..	7/32— 3/16	7/32— 3/16	..	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1 — 1 1/16	1 — 1 1/16	20/3	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	104 —106 xd	104—106	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	5 — 5½	5 — 5½	..	..	..
24,500	Potteries E. Trc., 20,001 to 40 000 & 50,001 to 54,500	10	..	5 %	5 %	..	8¾— 9½	8¾— 9½	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	9½— 10½	9½— 10½	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 — 106	..	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	10 %	33 — 35	33½— 35½	34½	34	+ ½
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102 xd	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	97½— 98½	98 — 99	..	..	+ ½
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3 %§	94 — 97	94 — 97	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8⅓%	6 %§	..	..	1¾— 2¼	2 — 2½	45/-	43/9	+ ¼
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	..	..	3½ — 4¼	4 — 4½	83/9	82/6	+ ¼
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	82 — 87	82 — 87	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅓%	4 %§	5¼— 5⅜	5¼— 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	9 %	8¾— 9¼	8¾— 9¼	8⅞	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	9 — 9½	8¾— 9¼	..	..	+ ¼
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..
80'000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %§	5⅞— 6⅛	6 — 6¼	..	..	..
80'000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	6¼— 6⅜	6¼— 6⅜	..	..	..
40'000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4⅜— 4⅝xd	4⅜— 4⅝	..	..	..
40'000	Do. do. 1903	5	..	4½%	4½%	4½%	4⅜— 4⅝xd	4⅜— 4⅝	..	..	..
420'000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	4½%§	5 — 6	5¼— 5⅜	5⅜	..	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%§	108 —110 xd	108 —110	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	5 %	11 — 12	11 — 12	11⅞	11⅜	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	13¼— 14½	13¼— 14½	13¾	13½	..
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —126 xd	122 —126	..	..	..
500,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103 xd	101 —103	102¼	..	..
40,000	County of Durham Electrical Power, Ord.	2	..	..	..	..	2 1/16— 2 1/8	2 1/16— 2 1/8	..	..	..
50,000	Do. do. do. 5 % Pref.	5	..	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	4 %§	8¾— 9¼	8¾— 9¼	9⅛	8⅞	..
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	12⅜— 12¾	12⅜— 12¾	12⅝	12 5/16	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	110 —113 xd	110 —113	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —103	102¼	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	..	5¼— 5⅜	5 — 5¼ xd	5⅛	5 3/16	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	5⅞— 6	6⅛— 6¼	6⅛	5⅞	— ⅛
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	107 —109	104 —106 xd	103⅜	105	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	4 %§	5¼— 5⅜	5¼— 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5¼	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	8 %	8¼— 8⅝	8¼— 9¼	..	..	+ ⅛
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	8 %	6 — 7	7⅛— 8¼	..	..	+1½
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	94 — 97	92 — 94	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —101	97 — 99	..	..	—1
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	•12½%	12 %	10 %	10⅜— 11⅝	10⅜— 11⅝	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	..	1⅞— 2⅛	1⅞— 2⅛	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅜	4⅞— 5⅛	..	..	— ⅛
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %§	9⅛— 10⅜	9 — 10	9⅜	9⅛	— ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5¼— 5⅝xd	5¼— 5⅛	5⅝	5 1/16	..
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	107 —111 xd	107 —111	..	..	..
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	96	95	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	99 —101	99 —101%	..	..	..
57,009	Newcastle-on-Tyne, 1 to 57,009	5	..	8 %	8 %	2½%§	8 — 8¼	8 — 8¼	..	..	..
17,991	Do. 57,010 to 75,000	5	..	..	..	2½%	8 — 8¼	8 — 8¼	..	..	..
57,009	Do. 5 % Pref., 1 to 57,009	5	..	5%	5	5 %	6⅛— 6⅜	6⅛— 6⅜	..	..	..
17,991	Do. 57,010 to 75,000	5	..	..	..	2½%	6⅛— 6⅜	6⅛— 6⅜	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	6 %	13¾— 14⅜	13¾— 14⅜	13 13/16	13⅜	..
64,800	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	5 %§	6⅜— 6⅝	6⅜— 6⅝	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	100 —102	99 —101 xd	98½	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	10%§	12¾— 13¼	12 — 13	12⅝	12¼	— ⅜
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %§	7⅜— 8⅜	7 — 8	8⅛	7⅜	— ⅝
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	97 — 99	97 — 99	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	..	2 — 2¼	2 — 2¼	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	..	3 — 3¼	3 — 3¼	66/3	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	..	1/32— 1/16	1/32— 1/16	..	..	— 1/32
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..
148,232	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	4⅜— 4⅝	4⅜— 4⅝	..	..	+
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5 — 5¼	5 — 5¼	5⅜	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	105 —107	105 —107	105½	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %§	11¼— 12½	11¼— 12½	12	11 3/32	..
28,151	Do do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 6⅝xd	5⅜— 5⅜	5 3/32	..	— 3/32

Shares not officially quoted :—Mackay Companies, ord., 61—62. Pref. 76—77.

† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 4 per cent. (September 28th, 1905).

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Conversive Ladders.

Workmen are often sent out to jobs where requirements of ladders and steps vary from day to day, and they may be "hung up" for want of a longer or shorter ladder, with the result that time is lost. Mr. Heathman, the ladder maker of Parsons Green, Fulham, has sent us particulars of his latest patented improvements, as illustrated in fig. 1. This enables four ladders to be available for use separately, or converted into two pairs of trestles, or two extending ladders adjustable at various heights, which can be coupled to form one tall trestle of varying height, and yet further, the whole four ladders may be connected in extension to form one tall ladder to rest against walls, &c. When taken apart they are easily carried about and into awkward positions, while they may be conveniently stored indoors out of the reach of bad weather and burglars. The folding platform can be hooked on to any rung at either back or front, and used to place tools upon, or for standing comfortably upon, the user remaining safely free to use both hands at work.

HEATHMANS PATENT COMBINATION STEP LADDERS
FORM SEPARATE LADDERS, OR TELESCOPIC
EXTENDING LADDERS, OR SELFSUPPORTING STEPS
OR TRESTLES. WONDERFULLY USEFUL.

Fig. 1.—Heathman's Conversive Ladder.

New Electric-driven Pump.

We illustrate the new Oddie-Barclay pump, driven by an electric motor; it is specially designed to occupy small space. We are informed that the trials have shown a pump efficiency of 86 to 87½ per cent. The pump has controlled suction valves, but the delivery valves are uncontrolled, except that they are loaded with springs. All the mechanism, which is simple, and consists of very few parts, is on the outside, and therefore readily accessible. The control of the suction valve admits, of course, of a high speed, and the average ram speed used is 300 ft. per minute, though it is found that higher speeds are perfectly practicable and satisfactory. The makers, Messrs. Andrew Barclay, Sons & Co., Ltd., Kilmarnock, are specialising in electrically-driven pumping plant.

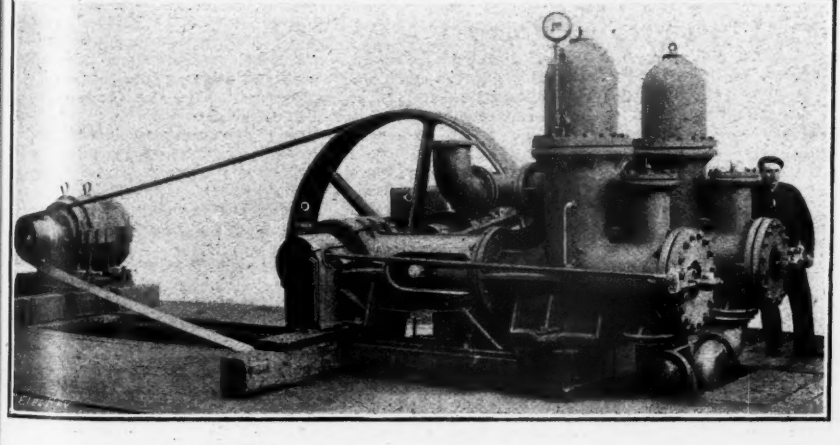


Fig. 2.—Oddie-Barclay Motor-driven Pump.

Wages Calculator.

In the accompanying fig. 3 we illustrate the Smith-Davis piecework balance and premium calculator, which is being supplied by Messrs. John Davis & Son (Derby), Ltd., of All Saints Works, Derby. It is a time and labour-saving device employed in the case of piecework, for quickly finding, without calculation, the proportion of the total balance money that is due individually to any number of men sharing profits on the same contract, the divisions being proportional to each man's fixed daily or weekly money rate. When work is paid for on the premium system, the instrument can also be used for finding the time allowance that is to be added to the actual time occupied on the contract. The instrument is provided with scales approximately 11 ft. long, having a range from 1d. to £20, and marked so that they can be used either for money or time calculations. The scales, divided on strips of celluloid, are affixed to the rims of two similar wheels, and so arranged that the divided edges come together. The wheels are mounted on a spindle which is carried at each end in bearings formed in a supporting stand made of wood. One wheel is fixed to the spindle, while the other is free to revolve upon it. The free wheel is pressed against the fixed wheel by a spring which is sufficiently strong to cause it to turn with the fixed wheel when the latter is rotated. To facilitate the setting of the scales with respect to one another, a treadle gear is arranged to take the pressure of the spring, so that when the fixed wheel is held by the left hand the free wheel can easily be rotated by the right hand in either direction; when the desired relative position of the two scales has been obtained, the treadle is released, and the two wheels are automatically locked firmly together. For piecework it is convenient to use the left-hand scale as the "wages scale," and the right-hand scale as the "balance scale." A list issued by Messrs. Davis explains the method of using the instrument by an illustration and example. The instrument is claimed to obviate all calculations, to save all reference tables, to be a valuable time-saver, &c. Although £20 is the highest figure on the scale, sums greater than £20 can with equal ease and rapidity be dealt with.

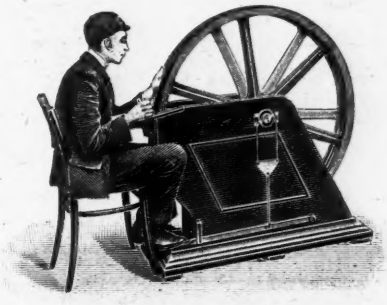


Fig. 3.—The Smith-Davis Calculator.

The "Reflex" Lamp.

We recently visited the Britannia Electric Lamp Works, Ltd., of South Tottenham, London, N., to see a demonstration of their new patent "Reflex" lamp, which is illustrated herewith (fig. 4).

Fig. 4.—The "Reflex" Lamp.

This is quite a novel device, consisting of a tubular lamp fitted with a screwed shoulder, upon which is carried a reflector; the latter is of a peculiar shape, and is provided with a transparent dome to protect the lamp bulb. The dome is of approximately uniform thickness, and therefore has no effect upon the light, but the reflector appears to be very well designed for its purpose, for the rays from the lamp are concentrated by it to a remarkable extent. It is claimed that over a horizontal area 10 ft. square a light is obtained equal to that of eight ordinary 16-c.p. lamps in a vertical position. Tests at the Westminster Electrical Testing Laboratory showed for the lamp without reflector a maximum horizontal effect of 19 c.p.,

vertical 10·9 c.p.; with the reflector the vertical intensity was 84·5 c.p. at a distance of 49 in. The lamp consumed 68·5 watts, equal to 3·60 watts per maximum horizontal candle-power, and 6·28 watts per vertical candle-power without reflector, and 0·93 watt per vertical candle-power with reflector.

We were privileged at the same time to inspect the works, which are in course of considerable extension; several important improvements in manufacture have been effected by the company, which cannot be made public as yet, but we understand that they are prepared to supply high-voltage lamps of 2½ to 3 watts per candle under firm guarantees as to maintenance of candle-power and duration of useful life.

The technical director of the works, Mr. S. Horvath, has been associated with glow lamp manufacture from its earliest days, and has gathered a fund of experience excelled by that of but few lamp makers.

The Munro Fire Detector.

The Munro fire detector is claimed to be of such small dimensions that it may be installed in any room without being unsightly, while it will give an instantaneous alarm of fire at any temperature, will stand vibration, and is yet immune from the dangers of false alarm and from deterioration on account of age or atmospheric action. It is stated that one detector fixed to the ceiling will protect a floor area of, say, 3,000 sq. ft., and will ring an alarm bell a few seconds after the bursting into flame of a newspaper or other material; in the case of a smouldering fire it acts as soon as a temperature of 160° F., or any other predetermined point, is reached; but it is, of course, not affected by the mere lighting of

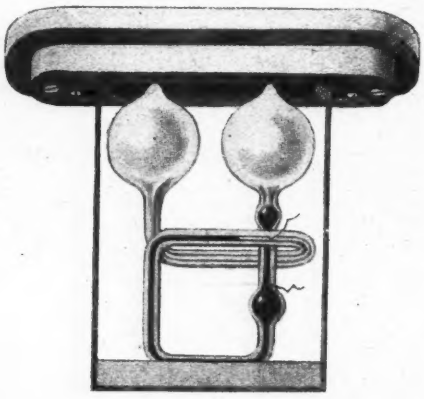


Fig. 5.—Munro Fire Detector.

fires, gas jets, &c. Every installation is fitted with one or more, indicators and alarm gongs, set in action by the detector, which is said instantly to locate the outbreak. A list relating to the device has been issued from 17, Hart Street, Bloomsbury Square W.C.

A NEW TYPE OF FREQUENCY METER.*

By A. S. Langsdorf.

Under the above title the author presented a paper at the convention of the American Association for the Advancement of Science, held in December, 1903, but the paper was not published except by

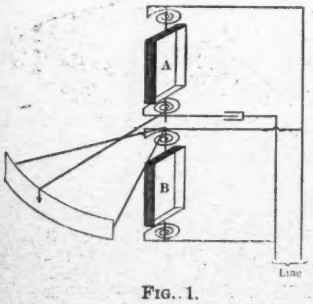


Fig. 1.

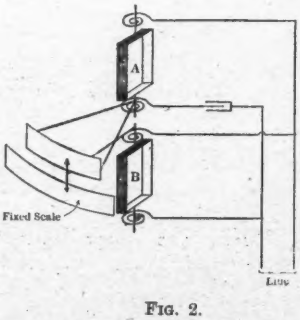


Fig. 2.

title. In June, 1904, the device originally described by the writer was independently conceived by Mr. J. F. Begole, of the Wagner Electric Mfg. Co., and it has recently been placed on the market.

The principle involved in this instrument is based upon the fact that if an alternating (sinusoidal) electromotive force of E volts and frequency f is impressed upon a condenser of capacity C farads, the current may be expressed in amperes as

$$2\pi f E C.$$

In other words, for a given value of C, the indications of an ammeter will be proportional to the frequency, *provided* E remains constant, in which case the scale of the ammeter can be graduated to read directly in cycles.

It is, of course, evident that the assumption of constant electromotive force is not justifiable where commercial circuits are concerned. If the scale of the ammeter mentioned above were graduated to read cycles, a change in line voltage would be recorded as an apparent change in frequency. This difficulty can be overcome, however, if the scale of the ammeter is itself movable, and is pivoted on a line coaxial with that of the pointer or indicator of the ammeter; if the motion of the scale, due to a change of voltage, is made equal to, and in the same direction as that of the ammeter needle, there will be no relative motion between the two, and the reading will remain unaltered.

To secure this compensating scale motion, the scale need only be attached to a bobbin which is constructed in all respects like that of an ordinary voltmeter, this voltmeter winding being then connected across the line.

The mechanical construction and electrical connections of the instrument will be easily understood by an inspection of the diagram, fig. 1. A is a bobbin to which the pointer is fastened, and which carries the condenser current. Directly below (or above) it is mounted the bobbin, B, which carries the graduated scale.

As the instrument is actually constructed, advantage is taken of the fact that the presence of bobbin B permits of voltage indications also; this latter idea is due to Mr. Begole. Fig. 2 is a diagram of the combined voltmeter and frequency indicator. The scale and pointer of fig. 1 are here interchanged, A now carrying the movable scale and B the pointer; an extension of the latter, moving over a fixed scale, indicates volts.

* *Electrical World and Engineer*, December 16th, 1905.

PROCEEDINGS OF INSTITUTIONS.

The Maintenance of Underground Mains.

By George L. Black.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Glasgow, January 9th*, 1906.)

The paper deals with the system of mains in the City of Glasgow.

The high tension mains are three-core cables, paper insulated, lead-covered and armoured; for the most part they have been drawn into earthenware ducts laid in concrete.

The low-tension feeders consist of triple-concentric cables all of 1 sq. in. × 1 sq. in. × 0·3 sq. in. Some have impregnated jute or paper insulation with a lead sheathing, and others paper insulation with vulcanised bitumen sheathing. All these are laid on the solid system in either cast-iron, earthenware, or impregnated wooden troughing. Most of the distributing network also consists of triple-concentric cables, and of the same classes of cables, laid in the same fashion as the feeder mains. After experience of all the above cables and troughing for low-tension work, the paper-insulated bitumen-sheathed cable, laid in wooden troughing filled in with pitch, has been adopted as the standard. The bitumen sheathing obviates the likelihood of electrolysis of a metallic sheathing, and leaves no chance for the trouble experienced when the sheathing of lead has become alive owing to a fault, and has caused arcing at a point perhaps far distant where the lead has been in accidental contact with earth. There are also in use as distributing mains parts of the original network laid out by Prof.—now Sir—A. B. W. Kennedy, in 1893. These consist of single armoured cables, jute insulated and lead covered, some copper strip in cast-iron culverts, and single rubber cables drawn three into cast-iron pipes. The low tension feeders have been run as far as possible in groups, and at various convenient points, such as feeding point chambers, are looped in and out again. This allows changes in the feeding arrangements to be easily and quickly made in cases of emergency and as the load varies from time to time during the year. The feeders terminate at the distributing end in large cast-iron underground chambers, to which are brought the whole of the distributing cables for the various streets in the neighbourhood of the feeding point. The feeder is connected directly without fuses to three main bus-bars, and the distributors are connected through fuses to the positive and negative bars, and directly without fuses to the neutral bar. As a rule, eight or ten distributors radiate from each feeding point. These distributors have no connection with one another, nor with any distributor connected to any other feeding point. The four-way and eight-way disconnecting boxes at street corners are also made of cast-iron, and have bus-bars and fuses similar to those in the feeding-point chambers. During the last two years a considerable number of section pillars have been erected instead of underground manholes.

In 10 years' extensive experience of all sizes of cables, the author has come across only two cases of faults in manufacture. It is desirable, however, that tests should be made on cables immediately after laying and before jointing the different lengths. High-tension cables should be first tested for insulation between cores

and to earth, then subjected to a pressure test of at least double the working pressure for 15 minutes, and then again tested for insulation as before.

Low-pressure cables should be tested for insulation, and may also be subjected to a pressure test. A systematised and periodical method of testing should be devised and carried out from day to day.

Fig. 1 illustrates an arrangement which has been devised to meet as far as possible any contingency arising in respect to an "earth" coming on either the positive or negative side of a network. Its leading advantage is the fact that under normal working conditions the neutral conductor is always at earth potential, and should an "earth" occur, the leakage current is kept down to such an amount that steps can be taken to locate the bad section while the supply is still on the mains. Besides saving the heavy rush of current which takes place on the blowing of a network fuse, the inconvenience to consumers entailed in a stoppage of supply is obviated. Should an "earth" come on either positive or negative side, the ammeter will immediately indicate the faulty side of the system. If the leakage current is less than 12 amperes, the only indication of the disturbance will be on the scale of the ammeter. If the current, however, exceeds 12 amperes, the ammeter will be short-circuited by its switch dropping, and if the current exceeds 50 amperes, the fuse will be blown, and the bank of incandescent lamps will light up. These lamps immediately draw attention to

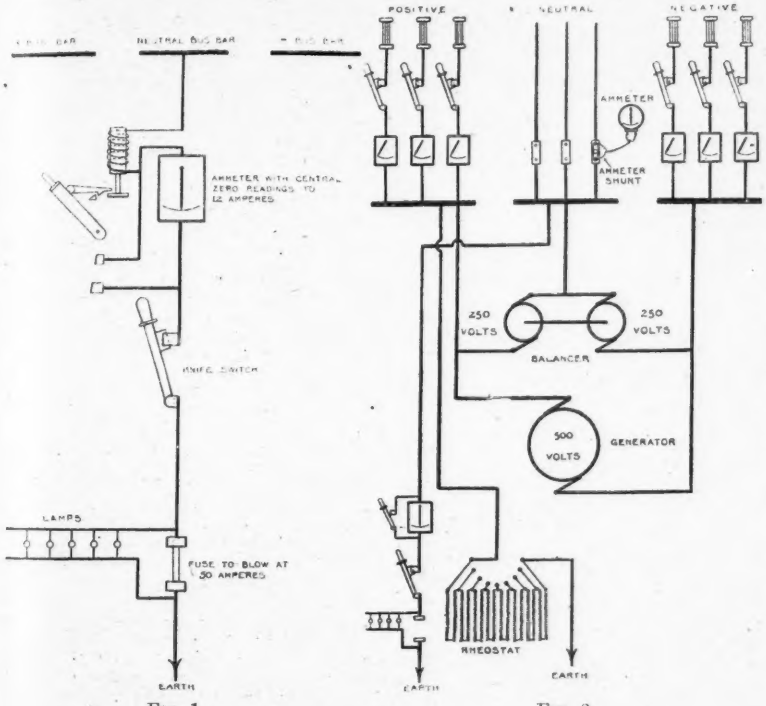


FIG. 1.

FIG. 2.

the fault, and it now becomes necessary to locate the district in which it has occurred. The knife-switch is opened and a new fuse inserted, and the neutral conductor is flashed to earth by quickly closing and opening the switch. At the same time the feeder ammeters are watched, and the fault will be on the feeder or a section of the network attached to the feeder whose ammeter shows a sudden rise in current at the instant the neutral bus-bar is earthed.

The circumstances are now reported to the Mains Department staff, who proceed to the feeding point in question, and find the bad section by drawing in turn the various network fuses on the faulty side of the system. Immediately the fault is disconnected, the potential of the neutral conductor comes back to that of earth, and the bank of lamps at the station or sub-station goes out. The man who draws the fuses can test for himself as he goes along, by

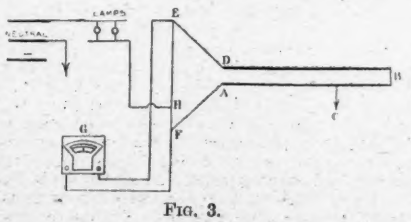


FIG. 3.

connecting a lamp between the neutral conductor and the earth bar in the feeding-point chamber.

The neutral conductor being normally at earth potential, and therefore, so to speak, not under test, it becomes necessary to ascertain that its insulation resistance is not deteriorating, and the following is a useful method of testing it (see fig. 2). A central zero ammeter, or an ammeter shunt capable of carrying, say, 500 amperes, is connected permanently between the neutral bus-bar in the station and the neutral conductor of each feeder leaving it. A reading of the out-of-balance current (amount and direction) on each feeder is taken and noted. The positive or negative bus-bar is then gradually earthed through a resistance, which is cut out step by step until a fairly large current is passing through it. A second set of readings is now taken of the out-of-balance current on the various feeders, and compared with the first set taken. The difference in the readings is the amount of current passing through any weak spot on the neutral conductor and earth. This test should be taken about once a week. In Glasgow it had been the means of discovering several cases of mechanical damage to cables, caused by the operations of other departments of the Corporation, engaged in street openings. It is especially useful where the outer or neutral conductor only of a triple-concentric main has been injured, as the warning provided gives an opportunity of having repairs effected before moisture gets in and causes a short-circuit between the outer and inner conductors.

The different classes of mains and some of the troubles experienced with them may now be considered.

The principal cause of breakdown in rubber-covered cables in pipes is damp. Faults have frequently been found near tee-joints, caused by the double-vulcanising or over-vulcanising of the rubber.

Armoured cables, laid direct in the ground or on the solid system, are usually lead-covered, and great care must be taken that the lead sheathing is made electrically continuous and well earthed, otherwise one fault occurring may cause numerous others. If laid in ground containing ashes, the life of the steel protection of armoured cables is very short. Armoured cables should be spaced a few inches apart, and bricks or other incombustible material placed between to prevent trouble spreading from one cable to another.

Of triple-concentric cables on the solid system, lead-covered cable laid in cast-iron troughing has been the least successful of the classes used. It was found almost impossible to prevent the lead sheathing from touching the troughing. This prevented proper filling, and was the cause of trouble through arcing.

Earthenware troughing was also used, but was costly. Finally wooden troughing creosoted or treated by some similar process was decided upon, and only vulcanised bitumen-sheathed cables used. The first of these cables had jute insulation between the conductors; others had vulcanised-bitumen insulation throughout. The V.B. throughout insulation makes the cable of large diameter; the insulation resistance between conductors is low, and there is danger at times of overload of the conductors decentralising and short-circuiting; also the fittings for branch connections and end-boxes have to be much larger, and are, therefore, more costly. Paper insulation possesses the advantage of having high insulation resistance, it does not fray when cut for branches as does jute, and altogether makes a compact, serviceable cable. This class of insulation with the bitumen sheathing has, therefore, been adopted. Sometimes a fault takes a long time to develop, and meantime water creeps in and runs up the core. Such wet cable has, of course, to be cut out. To stop this as far as possible, all the Glasgow low-tension cables supplied during the last four years have had their conductors impregnated with a heavy, sticky oil, almost of the nature of an insulating compound, and the result has been most satisfactory.

To come now to the tests employed for the localisation of faulty spots on cables, after the bad section has been found. These faults may be roughly divided into two classes—(1) Earths, (2) short-circuits.

Fig. 3 shows the connections for a loop test. A B is the faulty cable, the earth being at C; a loop is made by connecting a sound cable, B D, to the faulty main at B. Where the cables are "singles," B D may be one of the other cables on the same length of main. In the case of triple-concentric, one conductor may be sound and can be used, or it may be necessary to stretch a temporary cable along the ground, being careful to take into account in working out the test any differences in sectional area between the two arms of the loop. A and D are connected by short leads, of preferably the same sectional areas as the main under test, to the ends of a slide bridge E F. A low-reading milli-voltmeter with central zero or other suitable galvanometer is connected E F. The total length of loop, E D B A F, is measured. A couple of incandescent lamps are connected to the nearest positive live main and to the slide H of the bridge; H is now moved along E F until a point is reached when the galvanometer indicates that the loop is balanced.

The total length of the loop E D B A F is known:—

$$\text{then F A C} = \frac{\text{EDBAF} \times \text{HF}}{\text{EF}}.$$

In the absence of refined apparatus, it may be mentioned that a few feet of No. 20 copper binding wire stretched on a piece of wood

or across a jointer's tent makes quite a handy slide bridge. Sometimes, in opening at the spot indicated at the test, no sign of the fault is seen. It may be only a yard or so away, but there may be nothing to indicate in which direction to open up further. If the main be lead-covered, fig. 4 shows connections for a simple test to indicate this. It is presumed that the lead sheathing is earthed at both ends of the cable. A small bank of lamps taking about two amperes is connected to the core of the main at

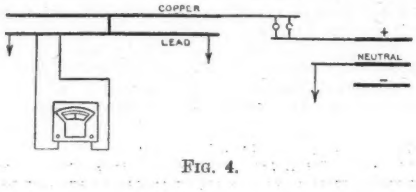


Fig. 4.

the nearest disconnecting box. The current on getting to the fault will split in two, and travel along the lead to the two ends of the cable. A low reading milli-voltmeter connected across, say, 3 ft. of the exposed lead will indicate in which direction the current is passing, and will show the side the fault is on. Short-circuits which are also "earths" may also be found by the loop test, if a loop can be made by some adjoining cable or other means. Owing to cross streets intervening, it is not always possible to stretch a temporary cable along the street, and fig. 5 shows a test which has been successful in such cases in finding "shorts" in triple-concentric cables.

A B C D and E F are the three conductors in the cable, E F being the neutral. H is the point of short-circuit. E F is coupled up at one end to the general neutral of the system. Two or three incandescent lamps are connected between the nearest positive live main and the positive conductor of the bad cable. A milli-voltmeter or galvanometer is connected across A C, its reading being g_1. The test is repeated at the other end, the lamps being connected to B and reading g_2 taken across B D.

The length A B is known :—

$$\text{then } \frac{A\,H}{A\,B} = \frac{g_1}{g_1 + g_2};$$

$$i.e., A\,H = \frac{A\,B \times g_1}{g_1 + g_2}.$$

Care should be taken in carrying out the last test that the drop in potential is not likely to injure the milli-voltmeter. Short-circuits may occasionally be found by measuring the drop of potential of a heavy current passed through the fault, taking

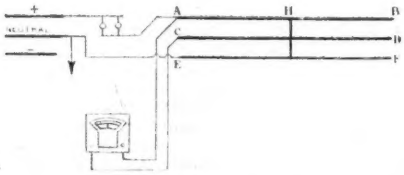


Fig. 5.

the current either from the live mains through a resistance or by means of a motor-generator. Arcing, however, is set up at the point of short-circuit, and may interfere seriously with the result.

In any electricity undertaking much attention has to be given to the upkeep of underground chambers, manholes, section-pillars, &c. In Glasgow a regular staff of inspectors go over each of the above once a fortnight, clearing out accumulations of dust, water, or other sediment. They also renew bad fuses and keep the boxes well painted. The different connections are painted distinctively according to polarity. This prevents mistakes, and gives the boxes a smart appearance. In connection with fuses, zinc is now in use instead of tin. It has the advantage of being a non-arcing metal, and it is very much cheaper than tin.

For indicating the presence of water in manholes on the route of the high-tension mains, an interesting device is being fitted. A multiple-core cable containing a wire for each manhole has been run from the generating station, where there is an indicator board and electric bell. In each manhole is a float, which closes the circuit when the water rises to a certain height. The corresponding indicator drop falls, and the bell rings, giving warning of the presence of water in the manhole.

Conclusion of Discussion on Mr. Patchell's I.E.E. Paper on the Charing Cross Co.'s City of London Works.

This discussion was concluded on the 11th inst., when Mr. Patchell replied at some length to his numerous critics

Mr. V. A. Fynn, discussed the question of the presence of nitric acid, which Mr. Highfield attributed to silent discharge alone, and the author to inferior insulation. The speaker thought that impurities in the insulation were responsible for the trouble, and that Mr. Highfield had only reproduced in his experiments the conditions existing in his own faulty machines, which proved nothing.

Mr. A. A. Campbell Swinton twitted the author on his foreign plant, which, if carried round the country, would form an excellent object lesson for tariff reform.

Mr. D. Wilson (of Messrs. Babcock & Wilcox) remarked that there were really no horizontal tube boilers, and those so-called, had tubes sufficiently inclined for ordinary work. Both soot and scale adhered to the vertical tube just as it did to an economiser tube. In his firm's experience so large a boiler unit as 100,000 lb. was wrong, and 30,000 lb. was the practical limit to size; further, it was possible to have too large a furnace. In the Navy his firm's boilers were burning 8 to 10 lb. per sq. ft. of h.s. on full load. He thought the author might well give further figures in regard to his plant, for comparative purposes.

Mr. A. H. Shaw criticised the use of a large boiler unit for supplying a large generating unit; he contended that several smaller boiler units would have been preferable, as any one could then be laid off without inconvenience. He further remarked that, although a 25 periodicity was generally held to be unsuitable for incandescent lighting, yet some 18,000 incandescent lamps were in use in Buffalo on that periodicity. He quite appreciated the author's trouble with surface condensers.

Mr. H. L. P. Boot agreed with the author that little would be gained by adding economisers to his plant, when sufficient tube and superheating surface was provided. It paid, of course, in the case of a Lancashire boiler. He was surprised to hear of the author's trouble with surface condensers; perhaps he used too hot water.

Mr. J. R. Walker, on the question of boilers, agreed as to the adoption of large units, but did not agree as to the use of the boilers as economisers and water purifiers in addition to their primary function of evaporators. The boilers at Bow could not act efficiently as purifiers and be kept at work continuously. From experience he believed that vertical tubes would scale as badly as horizontal ones. He inquired what the CO_2 record was when one grate only was used in the vertical boilers, and what staff was required at the station as a whole in comparison with a turbine plant.

Mr. Duddell thought there was no doubt that the destruction of the insulation of the H.T. windings referred to by the author was due to the production of nitric acid by silent discharging. He explained diagrammatically that the poorer insulating material on the winding inside the tube, would, owing to its causing a smaller pressure drop, tend to prevent the silent discharge. The insulating material was probably at fault where deterioration occurred, as Mr. Highfield had traced the presence of nitric acid at voltages varying from 14,000 to 3,000 above earth, while the author, with 8,000 volts above earth, had not been able to trace it. The speaker further demonstrated by means of oscillograph records the effect of switching on and off several miles of rubber-covered cable with air and oil-break switches, greatly to the advantage of the latter. A similar record with a transformer in circuit did not apparently improve the switching conditions, as generally supposed.

Mr. Patchell then replied. As to the Bow site; his company had to satisfy the City authorities as to position, and, further, had to obtain Parliamentary powers to link up by trunk mains, which naturally passed through as few local authorities' areas as possible. Tenders were received for the plant from English, American and Continental builders, but shortness of time led them to go to the latter, and for the sake of uniformity the same makers had had repeat orders. In regard to the use of high pressures, he had intended to point out that he both generated and used at 10,000 volts; Mr. Highfield's company certainly used a higher pressure, he was glad that that gentleman agreed with him as to the advantages of three-phase working. The only benefit of a 25 periodicity was on the line, there was very little elsewhere; 50 periodicity was chosen by his company, and it had been largely favoured by the Engineering Standards Committee. He favoured the use of mechanical stokers if they could be obtained to equal the elasticity of hand stoking. He had had under trial two types of underfeed stoker, but neither gave such good results as hand-firing, and it was really desirable to have half the boilers hand-fired for the purpose of meeting emergency loads. From tests made, it was found that the back sections of the large boiler really act as an economiser; while scaling was probably prevented by the rapid evaporation. The feed water derived from the artesian wells was from the chalk, but not from the outcrop, and it did not scale. Furthermore, there was evidence of plenty more water to be obtained by additional wells. In regard to the criticisms of the boiler proportions, &c., most of the speakers took nominal powers which might mean anything. As the feed-pump exhausts at Bow discharged into an open feed-heater, their economy was not a great point. The satisfactory application of superheating and reheating to a small isolated plant working under special conditions, as mentioned by one speaker, was hardly an argument in favour of applying such arrangements to a large generating plant, and the conditions were not comparable. In regard to the presence of nitric acid in the Willesden machines, he thought there was yet a good deal to be learnt about the latter. Some criticism had been offered on the system adopted in laying the trunk mains, but his company only had the choice of a solid or armoured system, and their choice had proved very satisfactory in working; furthermore, they were not allowed to build any boxes on the route. He had lately heard of a better joint than that used, in which micanite insulating tubes were adopted. The introduction of oil switchgear would probably render the use of cable charging gear unnecessary. Their practice was to put the cable on at the right frequency and at 4,000 volts pressure. He believed that the type of motor-generator adopted was the right one under the conditions obtaining, which, moreover, could not be compared with those

obtaining for lower pressures and different loads. Coal at Bow cost 13s. per ton delivered, and the coal consumption during the years 1902-3-4 and 1905, with load factors of 7·8, 10·66, 13·07, and 13·69 was 4·17 lb., 3·46 lb., 3·36 lb. and 3·58 lb. per unit respectively, delivered to the trunk feeders; during the last year small Welsh coal only was used. The speaker criticised the coal consumption given by Mr. Sparks for his stations, as being below the figures given by that gentleman at a previous discussion and less than the published accounts showed. He concluded by giving the coal consumptions of various other generating stations, including the following:—Neepsend (turbine plant) 13·4 per cent. load factor, 4·04 lb. per unit, delivered to mains; Berlin, 3·1 lb.; Frankfort (turbine plant), 3·92 lb., and Elberfeld (turbine plant), 4·37 lb. per unit generated. In his opinion the result over a 12 months' performance was the most trustworthy that could be obtained.

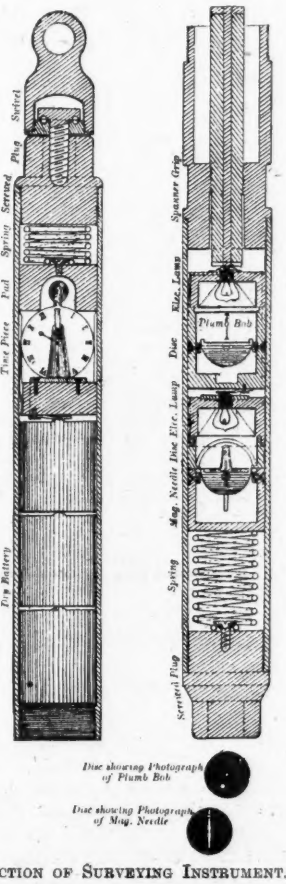
A New Instrument for Surveying Deep Bore Holes.

By J. B. Porter, D.Sc.

(*Abstract of Paper read before the Mining Section of the* Canadian Society of Civil Engineers, *November 30th*, 1905.)

It is a well-known fact that deep borings are seldom true, and, although artesian wells seldom depart very much from the vertical, owing to the method of drilling them, yet diamond drill-holes and other borings with rotary apparatus very frequently drift very far out of line. So long as the hole is not deep, this drifting is not a serious matter, but on holes of, say, 100 ft., the departure from line sometimes exceeds 10 per cent. In extreme cases, such as certain very deep recent borings near Johannesburg, holes which were intended to be vertical have drifted more than 2,500 ft. to one side of their aim.

In view of the great cost of these deep borings, it is extremely desirable that the exact location of cores brought to the surface



Section of Surveying Instrument.

should be determinable, and a number of devices have been introduced within the last few years for the purpose of surveying holes. Most of these devices are comparatively crude, and their use involves a great deal of labour.

A few months ago an instrument maker in Johannesburg designed a very ingenious apparatus containing compass, plummet, small cameras and electric light, the whole connected with a small adjustable clock, so that the light could be turned on for a given period after the apparatus had been lowered into the hole. It has been used in surveying a number of holes, and has proved extremely satisfactory.

The apparatus can be lowered on the end of a piece of flexible wire from a large reel, and thus several observations per day may be taken by two men.

The following brief description of the instrument is taken from the original paper by its inventor:—

Briefly described, this instrument is one in which both dip and deviation are recorded by means of photographs of the positions of both a plumb-bob and a magnetic needle at any desired point in a bore hole. The photographs are taken by means of two small electric lamps lit by a "time contact."

The instrument comprises a brass cylinder 20 to 30 in. long; both length and diameter are varied to suit the particular requirements. The cylinder is made in two portions, which screw together quite flush shoulder to shoulder. The top and bottom are closed by means of tightly-fitting screwed plugs. To the top plug is attached a brass swivel with an eye piece, by which the instrument is suspended. The swivel is fitted to the plug with ball bearings. The object of this swivel is to prevent the wire, which is used in lowering the instrument, from twisting; also, to minimise risk of the instrument kicking against the sides of the bore hole when being lowered or raised. Inside the cylinder, immediately beneath the top plug, is a spring resting on a pad, which keeps firmly in position a small watch or timepiece. Below the watch is a dry battery. Below this again is arranged a tiny electric lamp, and below the lamp is a glass plate, from the centre of which hangs a small plumb-bob. Below the plumb-bob is a circular brass plate supported on gimbal bearings, so that it always remains in a horizontal position. On this plate is placed a small disk of sensitised paper. Below this is another electric lamp, and below this again is a compass, which is also supported on gimbal bearings. On the dial plate of the compass is placed another disk of sensitised paper; each disk is pierced by a pin-prick in the centre, and another on one side, and both disks are fixed in exactly the same relative position, one above the other, when in the instrument. The whole is kept firmly in position from below by another spring placed under the little cup holding the magnetic needle, and resting on the bottom screwed plug. When the hand of the watch is passing the 12 o'clock point on the dial, it makes contact for about 15 seconds with a small projecting spring made of copper foil, which is connected with one line from the battery. The hand of the watch is connected with the other line, and so, when in contact with the spring, the circuit is completed; both electric lamps are lighted; and photographs are taken of the positions of the plumb-bob and the magnetic needle. It is only necessary to set the watch so that the hand will only pass the 12 o'clock point after sufficient time has elapsed to allow for the instrument being lowered to the required depth, and also to allow for the plumb-bob and magnetic needle having come to rest. In practice, it is usual to take readings at, say, every 200 ft. to 300 ft., and two readings should invariably be taken in each instance. When once the photographs have been obtained, the rest of the work is easy; for the height of the point of suspension of the plumb-bob above the centre of the disk being known, and the distance of the lower end of the plumb-bob from the centre of the disk having been obtained by accurately measuring the distance between the centre of the photograph of the plumb-bob and the centre of the disk, the angle of dip can be calculated. The direction is also easily obtained by placing the two disks in the same relative positions which they occupied while in the instrument, which can at once be done by means of the two pin-pricks on each. The direction of the line joining the centre with the image of the plumb-bob on the one disk will then (unless it happens to fall in the magnetic meridian) make an angle with the photograph of the magnetic needle on the other disk, and from this angle the magnetic direction of the path of the bore hole at that particular point is determined. In surveying a bore hole, say 4,000 ft. in length, two sets of readings should first be obtained at regular intervals, which should not exceed 250 ft. in length. When these have been obtained the dip and deviation must be calculated for each point, and then sufficient data are available to plot, in plan and section, the true path taken by the bore hole.—(*Proceedings* Institute of Mine Surveyors, Transvaal, May 27th, 1905.)

THE ELECTRICAL EQUIPMENT OF A D.C. TEST ROOM FOR AN ELECTRICITY SUPPLY UNDERTAKING.

By A. C. Johnson.

In many electricity supply undertakings, a well-equipped test room is considered of secondary importance, and, owing to the lack of proper appliances, the testing of electrical measuring instruments is wholly neglected, or only resorted to when some particularly strong-minded consumer insists on having his meter tested, or when the station records give abnormal results due to errors in the meters.

A few modern appliances conveniently grouped for carrying out an ordinary test greatly encourage the systematic and careful testing of meters; and as most meters now in use on consumers' premises tend to read slower as their life increases, the saving effected by these tests would probably account for a large portion of the missing units generally attributed to distribution losses. Station records are also of little value unless the different registering instruments in

use are periodically tested. There are various other purposes for which a well-equipped test room can be used, such as the milking of the station cells, the charging of ignition cells, the testing of lamps, &c., all of which contribute to the success of an electricity supply undertaking.

Description of the Test Room Equipment at Burnley.—The following is a brief description of the scheme designed and carried out by the writer to the requirements of Mr. R. Birkett, the late electrical engineer of Burnley. On reference to the appended diagram of connections (p. 119), it will be seen that the scheme consists mainly of a variable voltage motor-

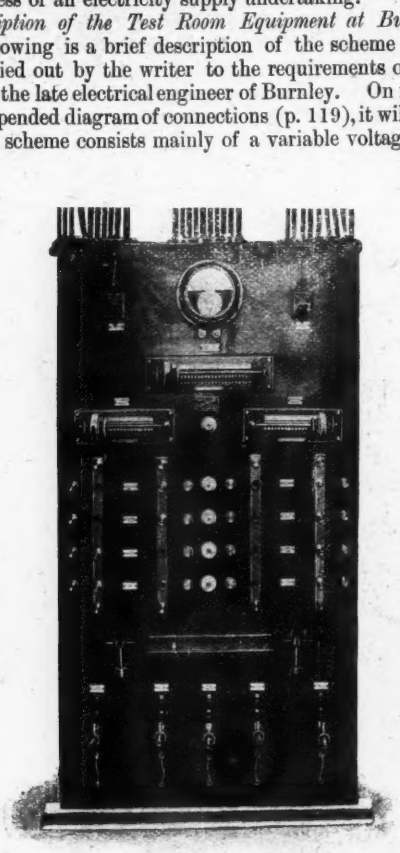


Fig. 1.—H.T. Board.

generator or booster and a storage battery. The motor is driven off a H.T. plugged board, which is also used for lamp tests and other H.V. tests. The generator feeds another plugged board, by means of which any standard ammeter and choking resistance can be plugged in circuit with any instrument to be tested, or with any cell to be charged.

Four supply mains at different potentials are led through fuses and switches to the four vertical bars on the H.T. board (fig. 1), hence four different pressures can be obtained between any one set (positive and negative) of horizontal bars, viz., 440, 330, 220, and 110 volts. The four sets of horizontal bars on this board are made use of as follows :—(1) Spare circuit used for testing arc lamps, &c.; (2) Circuit leading to the photometer room; (3) Generator field circuit; (4) Motor circuit. By suitable combinations of voltages at the motor and field terminals, and with suitable field rheostats, a wide range of voltage may be obtained at the motor terminals.

The generator leads are taken to the bottom set of horizontal bars on the L.T. plugged board (fig. 2); the same bars are also connected to the circuits used for milking bad cells in the station batteries. The other horizontal bars are connected, the one to the meter-testing circuit, and the other to a special circuit used for charging ignition batteries. The various standard ammeters and choking resistances are each connected to two consecutive vertical bars, as shown on the diagram, and by this means, any ammeter or ammeters may be connected, in series with one or all the resistances, to any of the above three distributing circuits. In addition, the two sets of outer vertical bars are made use of as follows :—The one is connected to the testing batteries and the other to a special 1,000-ampere circuit used for testing large station meters. This circuit is particularly useful for large wattmeters, such as are used on generators and feeders. Before this equipment was installed at Burnley, for any degree of accuracy, the B.T.H. traction wattmeters had either to be sent back to the makers to be tested, or they had to be run at considerable expense on an artificial load. Now any meter may be disconnected at night after shutting down the generating plant, and tested in a very short time and at very little expense. Two terminals at traction voltage are provided on the H.T. board for the meter shunts.

There are six storage cells; the maximum rate of discharge of each is 400 amperes during 15 minutes. They are divided into two sets of three, and these two batteries may be connected either in series or in parallel according to requirements, by means of two throw-over switches. For very heavy currents they are connected in parallel, giving together a discharge of 800 amperes at a voltage which can be regulated by the three-way switches shown on the diagram. If yet heavier currents be required, the generator is run in parallel with the batteries, giving a total discharge of over 1,000 amperes. It will be necessary to provide a resistance for adjusting the discharge from the batteries, but the booster, owing to its variable voltage, may be plugged direct on to the terminals of the instruments to be tested, and the final adjustment in load may be effected on the two field rheostats.

The standard ammeters in use at Burnley for testing purposes are of the Kelvin balance type, and owing to the high resistance of the smaller sizes of these instruments, it was found necessary to provide means for connecting the two

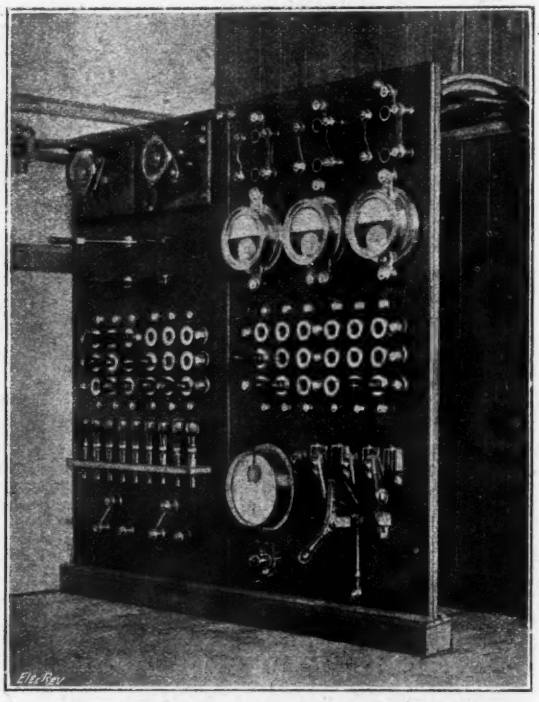


Fig. 2.—L.T. Board.

batteries in series. This series arrangement allows also of the six cells being charged simultaneously from the booster, which results in greater efficiency and saving of time.

The Booster.—The booster is the most important part of the plant and possesses some novel features. Tenders were invited from several electrical engineering firms, but there was the usual want of enterprise in departing from standard practice for small orders, and most of them asked to be excused from tendering on the ground that they had no patterns at hand for the special machine required. The work was eventually entrusted to the Keighley Electrical Engineering Co.

The booster consists of a motor and a generator, direct coupled and mounted on an extended bedplate. Both are of the four-pole type, but whereas the motor has only two sets of brushes, the generator has four sets and a large commutator to cope with the heavy currents required by the specification. The booster is provided with carbon brushes and runs sparklessly at all loads and voltages.

The shunt motor is specially wound, so that it can be driven with current at any of the following voltages:—110, 220 or 440 volts. The generator field is also wound for the above voltages. By suitably combining motor speed with field excitation, any voltage between ½ volt and 15 volts, can be obtained at the generator terminals *at any load between no load and full load.*

The maximum load on the generator is 200 amperes at 15 volts, and the generator is so proportioned, that at the lower voltages considerably heavier currents may be obtained for short periods without overheating. It is separately excited off the H.T. board, and regulating switches and rheostats are inserted in both the motor and generator fields, so that very fine adjustments in load can be effected without having recourse to the usual, but inconvenient, method of inserting

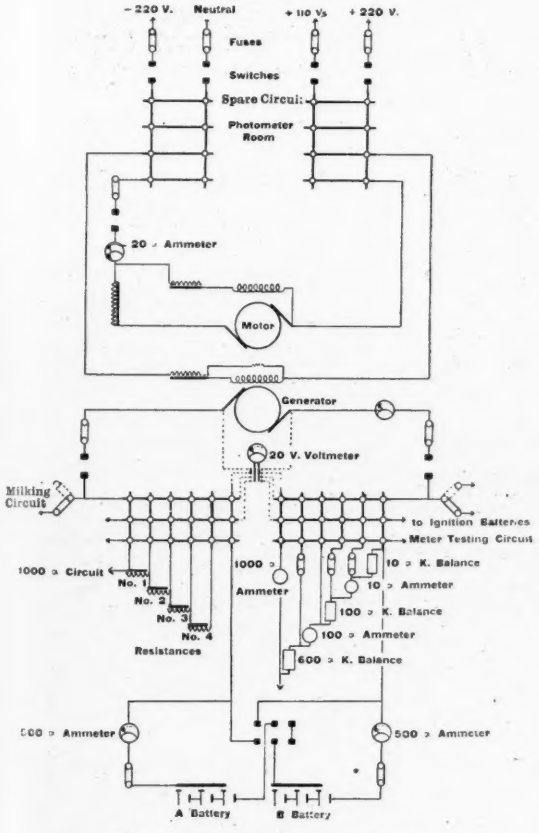


FIG. 3.—DIAGRAM OF CONNECTIONS.

resistances in the meter circuit. The approximate load may be obtained by the use of the generator field rheostat, and the finer adjustments by the use of the motor field rheostat. Most D.C. stations can only dispose of two voltages at the switchboard, and if the same range of pressure (14½ volts) is required at the generator terminals, the lower P.D.'s may be obtained by inserting a larger resistance in the generator field. It follows also, that if a sufficiently high resistance be provided, only one pressure need be applied across the generator field circuit, thus simplifying the H.T. board. This will, of course, necessitate a greater number of contacts on the regulating switch.

The booster was also installed with a view to milking bad cells in the station batteries. Mains run from the L.T. board to the different battery rooms, where they are placed in convenient positions for tapping off to any cell by means of two flexible leads with suitable clamps at both ends.

The Storage Cells.—The six storage cells were supplied by the Chloride Electrical Storage Syndicate. Each cell consists of 25 lead plates, measuring 9 in. × 10 in. The thin negative plates are separated from the positive plates by wood diaphragm separators. The makers claim a very high rate of discharge with their cells, making them particularly suitable for test room purposes where ampere-hour capacity is of secondary importance. The capacity of each cell is 400 amperes during 15 minutes.

Cost.—At first inspection of the diagram of connections, it would appear that the outlay on cables was considerable. It is desirable that the different parts of the plant should be grouped together. If the test room is built on a firm foundation, free from vibration, the booster may be erected inside the test room; the battery, however, should be placed in an adjoining room, or in a part of the test room partitioned off and well ventilated. The cable can generally be obtained at the cost of scrap copper, as most of the short lengths of cable condemned for distribution purposes can be made use of in the test room. The same argument applies to the switchgear. At Burnley, a large portion of the switches, fuses, ammeters, rheostats, &c., had been discarded for any other purpose; the L.T. board itself is an old disused board, refitted for the test room. The chief items of expenditure are therefore:—(1) The booster; (2) the storage cells; and (3) the labour on erection. The latter item may also be kept low by employing the permanent staff during spare time.

Revenue.—The whole of the capital invested could in most stations be recovered in a very short time through means which, although mostly indirect, will appeal to all central station engineers. They are various:—

1. The testing of meters does not in itself involve the use of much energy, and the saving is not to be looked for in this direction. But by offering greater facilities for testing, the above scheme will lead to periodical tests, and will, as pointed out above, account for the sale of an increased percentage of the units generated.

2. The testing of large station wattmeters is a special feature of the equipment. This is an important point, especially for corporations where the tramways and generating plant are under separate management. It frequently happens that friction arises between the two departments regarding the accuracy of the meters registering the amount of electricity sold for traction purposes. With the above scheme either department may check the wattmeters by a very simple test.

3. Another indirect, but very important, source of income, is derived from the use of the booster for milking cells in the station batteries. A very usual course adopted when a cell shows signs of weakness is to overcharge the whole battery to save one cell. This overcharge means dead loss of energy, and is detrimental to the battery.

4. In electricity supply stations the charging of ignition cells is often avoided owing to lack of proper appliances, or to time wasted in connecting up the cells. It will be seen, on reference to the diagram, that, with the above scheme, the connections from the testing battery to the ignition cells through resistances and ammeters, are made in a very short time. In the case of stations of moderate size, where the switchboard attendant has time to see to the charging of the cells, this item alone would warrant the investment in a small booster and battery.

5. A well-equipped test room should have a dark photometer room, so that the various lamps on the market may be tested for efficiency and economy. Encouraging the use of the best lamp is one of the best means of advertising the use of electric lighting.

The equipment has been in use some 18 months, and has proved of service in many ways, most of which are sufficiently well known to central station engineers not to need any further enumeration.

Steam Turbine Anomalies.—It is said that a steam turbine may lose many of its blades, in one case nearly the whole of the blades of the intermediate diameter, without loss of economy. Does not this remind one of the story of the first screw propeller, which was of considerable length, but the little vessel broke her propeller shorter on a rock, and ran faster as a result? It has long seemed to some engineers that there was a tendency to put too many rings of blades into a steam turbine, and that possibly fewer might be tried with advantage At best a steam turbine is very much of a compromise. Where the steam should run fastest the blades move most slowly, and the less active low pressure steam has to pass by the most quickly running blades. No doubt trial and error have entered largely into the method of turbine design; yet there may be some advantage in using fewer blades.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"CABLES" writes:—"An electrical contractor doing wiring at a building while other work was in progress, made use of builder's scaffolding erected by them, for doing his work; of course, they had put up scaffolding to do their work, and he did not delay or damage these goods; he simply used it as convenient. The builder sends in an account for a fairly good amount for use of scaffolding; no mention was made of it previous to this. Can he legally claim for this?"

*** Seeing that "Cables" made use of the scaffolding, it is thought that a Court of law would imply a contract to pay something reasonable. In order to raise the question, "Cables" should resist payment of the account, and make a tender of what he considers a reasonable sum. A legal tender is best made by offering a sum in actual cash. If the tender is refused, and the builders bring an action, the amount tendered can be paid into Court with a plea of tender. If the builders do not recover more than the amount tendered, "Cables" will be entitled to the costs of the action.

"QUERY" writes:—"I shall be much obliged if you will give me an answer to the following in the legal column of the ELECTRICAL REVIEW:—I was recently appointed to a post at the electricity works, and in my letter confirming the appointment my salary was stated at so much per week. I find now that all salaries are paid monthly, and I want to know whether I am bound to give a month's notice in case I want to leave the situation."

*** The fact that a man's salary is paid "monthly" or "weekly" does not necessarily imply that he is entitled to a month's or a week's notice. In the absence of an agreement which specifies the length of notice, it is necessary to consider what is a reasonable notice—unless, indeed, the length of notice is fixed by some well-recognised trade custom. It is thought that a month's notice would be the more reasonable; but "Query" would be well advised to come to some definite arrangement with his employers in the matter.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

1. "Improvements in electric car trolley poles and swivelling heads for same." J. COWLEY. January 1st.

18. "Improvement in electric resistances, contacts and the like." H. S. HATFIELD. January 1st.

21. "Improvements in automatic circuit-breaking appliances for overhead trolley and other electric wires or cables." G. H. SIDEBOTHAM. January 1st.

24. "Improvements in or relating to electric cable conductors." W. E. HITCH. January 1st.

52. "Use of a special active material for manufacturing accumulators." C. JEANTAUD. (Date applied for under Patents Acts, 1901, January 5th, 1905, being date of application in France.) January 1st. (Complete.)

53. "Improvements in connection with the regenerative control of electrically-propelled vehicles." J. S. RAWORTH. January 1st.

57. "A magnetic differential gear for automobiles." E. ROUSSEAU. January 1st.

76. "Improvements in the electrolytic manufacture of metal wire, strip or the like." S. O. COWPER-COLES. January 1st.

77. "An improved process for the electrolytic manufacture of metallic wire or strip." S. O. COWPER-COLES. January 1st.

78. "Improvements in the electrolytic production of metallic strip." S. O. COWPER-COLES. January 1st.

79. "Improvements in the manufacture of copper wire, strip or ribbon." S. O. COWPER-COLES. January 1st.

131. "Improvements relating to electric furnaces." C. E. PETTIT. January 2nd.

132. "Improvements in electric furnaces." C. E. PETTIT. January 2nd.

134. "An improved mouthpiece for telephones and speaking tubes." G. J. SMITH. January 2nd.

140. "New outside sign illuminated with gas, electricity or oil." P. G. MERK. January 2nd.

146. "A process and apparatus for electrolysis of alloys, fused salts, solutions, ores or chemical compounds." E. A. ASHCROFT. January 2nd. (Complete.)

175. "Improvements relating to the regulation or control of electric motors." JOHNSON-LUNDELL ELECTRIC TRACTION CO., LTD., and J. G. V. LANG. January 2nd.

215. "An improved arc lamp." A. J. POOL. January 3rd.

222. "Improvements in vapour-electric converters." P. H. THOMAS. (Date applied for under Patents Act, 1901, January 13th, 1905, being date of application in United States.) January 3rd. (Complete.)

223. "Improvements in mercury-vapour electric lamps." C. A. LEE. January 3rd.

234. "Improvements in galvanic cells." H. A. E. W. L. FEMELING and F. W. PORSCKE. January 3rd.

238. "Improvements in single-phase alternate-current commutator motors." V. A. FYNN. (Date applied for under Patents Act, 1901, April 15th, 1905, being date of application in Germany.) January 3rd. (Complete.)

250. "Improvements in automatic switches for overhead electric tramway systems." E. EARNSHAW. January 4th.

280. "Improvements in controlling devices for electric motors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) January 4th.

292. "Improvements in or relating to high pressure electrical apparatus." A. J. BOULT. (F. J. Koch, Germany.) January 4th.

302. "Improvements in electricity meters." SIEMENS BROS. & CO., LTD. (Siemens-Schuckertwerke, G.m.b.H., Germany.) January 4th. (Complete.)

342. "An improvement relating to the tremblers of induction coils." S. J. WATSON and G. H. SMITH. January 5th. (Complete.)

351. "Improvements in electric motors of variable speed." S. P. THOMPSON. January 5th.

368. "Improvements in electrical switches." J. WHYTE. January 5th. (Complete.)

374. "An improved thermal electric switch." W. VAN DOREN KELLY. (Date applied for under Patents Act, 1901, August 30th, 1905, being date of application in United States.) January 5th. (Complete.)

376. "Method of and apparatus for influencing an electric circuit in dependence upon the load of a continuous current motor situated in another circuit." SIEMENS BROS. & Co., Ltd. (Siemens-Schuckertwerke G.m.b.H., Germany.) January 5th. (Complete.)

378. "Improvements in electrical signalling apparatus." SIEMENS BROS. AND CO., LTD. (Siemens & Halske Akt.-Ges., Germany.) January 5th. (Complete.)

385. "Improvements in and relating to electric measuring apparatus." THE BRITISH THOMSON-HOUSTON CO., LTD., and F. HOLDEN. January 5th.

418. "Improvements in casings for electrical arc lamps." F. W. E. SCHUER. January 6th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

ELECTRIC TELEGRAPHS. Siemens Bros. & Co., Ltd., and G. S. Grimston. 26,686. December 7th.

APPARATUS FOR CONTROLLING TELEGRAPHIC RECORDERS AND OTHER INSTRUMENTS. Marconi's Wireless Telegraph Co., Ltd., and E. Priddle. 26,748. December 8th.

MERCURY VAPOUR LAMPS. O. D. Lucas. 27,245. December 11th.

SYSTEMS OF ELECTRIC MOTOR CONTROL. British Thomson-Houston Co., Ltd. (General Electric Co.) 27,400. December 15th.

METHOD OF CONTROLLING ELECTRIC LIFTS, ELEVATORS, CONVEYORS, OR ANY SIMILAR CONTRIVANCE HAVING A MOVING CAR AND STATIONS. H. C. E. Jacoby. 27,844. December 20th.

MEANS OR APPARATUS FOR AUTOMATICALLY STARTING, CONTROLLING AND STOPPING, SINGLE OR MULTI-PHASE ALTERNATING CURRENT ELECTRIC MOTORS. O. Carr and J. C. Birch. 28,687. December 29th.

1905.

MEANS FOR ELECTRICALLY RECORDING WEIGHTS LIFTED BY A CRANE OR THE LIKE. C. Russo and E. C. Feinstein. 8,267. April 8th.

METHOD FOR SAFEGUARDING ELECTRIC UNIPOLAR CELLS. H. Grisson. 8,789. April 26th.

CONTACT BOXES FOR SURFACE CONTACT ELECTRIC RAILWAYS. G. L. Campbell and W. M. Stephens. 8,921. April 27th.

DEVICES FOR ELECTRICALLY OPERATING THE POINTS ON ELECTRIC RAILWAYS. V. Joksch, J. Petrik and R. Butta. 10,581. May 20th.

COUPLES FOR SULPHIDE OF COPPER THERMO-ELECTRIC GENERATORS. Cie. Thermo-Electrique (Système Hermite) Soc. Anon. (Date applied for under International Convention, May 3rd, 1905.) 11,301. May 30th.

INSULATORS OF ELECTRIC RAILWAYS, TRAMWAYS, AND THE LIKE. R. N. Tweedy. 13,062. June 24th.

CONTROLLING AND RECORDING APPARATUS FOR USE WITH ELECTRICAL INDICATING INSTRUMENTS. G. Harrison. (Electric Railway Improvement Co.) 14,465. July 13th.

DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co., Ltd. (General Electric Co.) 16,518. August 14th.

RECEIVERS FOR ELECTRIC WAVES. F. Schneider. 17,079. August 23rd.

RECEIVER SYSTEM FOR WIRELESS TELEGRAPHY. W. Harrison. (Date applied for under International Convention, August 26th, 1904.) 17,223. August 25th.

ELECTRIC LIGHTING APPARATUS FOR USE IN CONNECTION WITH CYCLES AND THE LIKE. J. Lewy. 18,432. September 12th.

ELECTRODES. M. Yasuda. (Date applied for under International Convention, January 21st, 1905.) 22,460. November 3rd.

ELECTRIC OIL AND LIKE SWITCHES. British Thomson-Houston Co., Ltd. (General Electric Co.) 522. January 10th.

METHOD OF, AND APPARATUS FOR, INDICATING OR CHECKING THE EFFICIENCY OF ELECTRIC TRAIN OR CAR DRIVING. McLellan and C. H. Merz. 571. January 11th.

ELECTRIC HEATERS. British Thomson-Houston Co., Ltd. (General Electric Co.) 3,289. February 16th.

ELECTROLYTIC METERS. G. Hookham and S. H. Holden. 3,327. February 17th.

STRUCTURE OF ACCUMULATOR CELLS. H. Leitner. 3,814. February 23rd.

IMITATION CANDLES FOR ELECTRIC LIGHT. B. M. Drake. 6,267. March 24th.

HANGERS OR EARS FOR OVERHEAD ELECTRIC WIRES. J. H. Simpson. 6,400. March 27th.

MERCURY VAPOUR ELECTRIC LAMPS. C. A. Lee. 6,755. March 30th.

ELECTRICAL SWITCHES. J. H. Tucker. 6,822. March 31st.

MEANS FOR SUPPORTING TELEPHONE RECEIVERS. F. W. St. John. 8,704. April 25th.

DETECTOR FOR USE IN WIRELESS TELEGRAPH SYSTEM. H. Shoemaker. 8,890. April 27th.

WIRELESS TELEGRAPH RECEIVING APPARATUS. H. Shoemaker. (Date applied for under Rule 5 Patents Rules 1905, April 27th, 1905.) 8,890B. April 27th.

REGULATING RHEOSTATS AND MOTOR STARTERS FOR ELECTRICAL PURPOSES. G. E. Fletcher. 12,062. June 9th.

ELECTRIC INCANDESCENT CANDLE FITTINGS. F. R. Pope. 12,536. June 16th.

ELECTRIC ARC LAMPS. British Thomson-Houston Co., Ltd. (General Electric Co.) 12,875. June 21st.

STERILIZER MOUTHPIECES FOR TELEPHONES AND THE LIKE. O. H. Savahe. 13,597. July 1st.

ELECTRIC MOTORS FOR USE WITH EITHER ALTERNATING OR CONTINUOUS CURRENTS. Allgemeine Elektricitäts Ges. (Date applied for under International Convention, July 4th, 1904.) 13,706. July 3rd.

APPLICATION OF ALTERNATING CURRENT TO WELDING AND OTHER METAL WORKING PROCESSES. V. Mitkevitch. 20,769. October 13th.

APPARATUS FOR AUTOMATICALLY MAKING AND BREAKING AN ELECTRIC CIRCUIT FOR LIGHTING AND EXTINGUISHING ELECTRIC LAMPS AT CERTAIN HOURS VARYING WITH THE SEASONS. E. Capt-Lecoultre. (Date applied for under International Convention, September 3rd, 1904.) 16,945. August 21st.

ELECTRICALLY-DRIVEN BLOWER FOR DRYING THE HUMAN HAIR. M. Dieckmann. (Date applied for under International Convention, February 11th, 1905.) 19,749. September 29th.